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Vol. VI.

DEVOTED TO THE ECONOMY AND LIFE-HABITS OF INSECTS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE.

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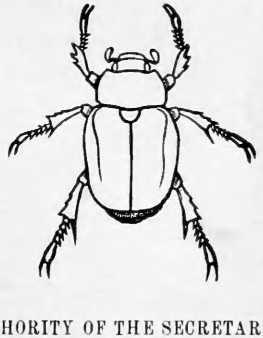

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SPECIAL NOTES.

Forest and Shade Tree Enemies in West Virginia.—Bulletins 31 and 32 of the West Virginia Agricultural Experiment Station, by Mr. A. D. Hopkins, published in April and May, 1893, respectively, contain much matter of interest to the student of forest insects. Bulletin 31 is a catalogue of West Virginia Scolytidæ and their enemies, but it is also something more than a catalogue. It gives rearing records and brief tabular accounts of the habits of 80 species of Scolytidæ and of 88 species of the natural enemies of these destructive beetles. In considering parasites Mr. Hopkins has carefully distinguished between those found simply associated with the supposed host; those which he considers to be primary, and those which he considers to be secondary. Although the records would have been of more value had the reasons for these conclusions been given, the list nevertheless marks an advance in this direction. It is interesting to note that Mr. Hopkins has reared 8 distinct parasites of *Scolytus rugulosus*, and a further remarkable observation is recorded in the fact that a Chalcidid of the subfamily Pteromalinæ was reared from the adult of *Pityophthorus minutissimus*, an observation which is without parallel in the whole family Chalcididæ.

Bulletin 32, which comprises a catalogue of the West Virginia forest and shade-tree insects, is naturally more extensive, and covers some 75 pages, giving rearing records of no less than 494 species. The bulletins are well printed upon good quality of paper, but are somewhat marred by the results of inexpert proof-reading.

Orange Insects in Louisiana.—The Louisiana Agricultural Experiment Station at Baton Rouge, La., has published a special bulletin on the subjects of the Orange and other Citrus fruits from seed to market, with insects beneficial and injurious, with remedies for the latter, by Prof. W. C. Stubbs, Director of the Station, and Prof. H. A. Morgan, Entomologist. The bulletin fills a great want, since we have no modern work in English on the cultivation of the Orange. Prof. Morgan's contribution to the bulletin is partly a repetition of our publications on the scale insects affecting Citrus trees in Florida and California, but is of great interest as indicating the particular insect fauna of the plants

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in the intermediate locality of Louisiana. Besides, the report contains many original observations by the author and a few new illustrations. Some account is also given of the scale insects which are liable to be imported into Louisiana. Original colored plates are given, illustrating the Oyster-shell Bark-louse of the Apple, the Purple Scale, the San José Scale, the Long Scale, the Yellow Scale, the Apricot Scale, and the Florida and California Red Scales, as well as the smut fungus, the Florida Ceroplastes, the Orange Mealy-wing, the Chaff Scale, and the Orange Chionaspis.

Bulletin 7 of the Washington Experiment Station.—Mr. Charles V. Piper, the newly appointed Entomologist to the Agricultural Experiment Station at Pullman, Wash., in Bulletin 7 publishes his first entomological information. He treats of the Pea Weevil and the Cottony Maple-scale, the accounts being mainly compiled. The Cottony Maple-scale, which he determines as *Pulvinaria innumerabilis*, is stated to occur upon Currant, Gooseberry, Plum, Pear, Hawthorn, Mountain Ash, Lombardy Poplar, Weeping Willow, Flowering Currant, the Upland Willow, and Swamp Willow. It does not occur upon either of the native maple trees, which are abundantly planted as shade and ornamental trees in that State. This fact in itself should have suggested to Mr. Piper that the Northwestern species differs from that of the East, as it really does, since numerous specimens received from the State of Washington have convinced us that the species is new, although properly placed in the genus Pulvinaria.

Bulletin 6 of the same station contains a short notice of the Woolly Root-louse of the Apple, with an interesting plate showing the roots of seedlings affected and unaffected.

Report of the Entomologist of the Louisiana Station.—Bulletin 22, second series, of the State Experiment Station at Baton Rouge, La., contains the reports of the officers for the year 1892. Prof. H. A. Morgan reviews his work of the season on pages 731–736. He reports that the Corn Root-worm (*Diabrotica 12-punctata*) destroyed many young corn plants, and that the greatest damage was done between the first of March and the first of May. Soaking the seeds of corn and melons in undiluted kerosene emulsion for twenty-four hours is stated to hasten germination and to ward off the attacks of the beetles. The adult insect is known in that part of Louisiana as the "Betsy Bug." Experiments with different solutions for use on cattle to keep off the Horn Fly showed that a fish-oil emulsion made by dissolving half a pound of common white soap in 1 gallon of boiling water, adding 2 gallons of fish oil while still hot and thoroughly churning the mixture for four

or five minutes, was more persistent in its protective effect than the other substances tried, which were Sludgite, Eucalyptus oil, Christ-Jeyes'fluid, and kerosene emulsion. The common Grass Worm (*Laphygma frugiperda*) was reported to have done considerable damage to the corn during the season.

The Department of Agriculture of British Columbia.—The second report of this Department, covering its operations for the year 1892, has just reached us. It is a bulky quarto volume and contains considerable interesting matter on the subject of insects. Aphididæ are reported to have been extremely abundant throughout the whole province, causing great loss to the hop and fruit crops. An inspector of fruit pests, in the person of Mr. E. Hutcherson, has been appointed, and he has been at work investigating the condition of the orchards in the different districts. Aside from plant-lice, Mr. Hutcherson reports that the Codling Moth is beginning to make its appearance, and states that the Plum Curculio has attacked the plums at Victoria. This announcement is one of great importance, if the observation should prove to be correct, as this insect has not been found west of the Rocky Mountains heretofore. The Flat-headed Apple-tree Borer and the Tent Caterpillars of the orchard and forest are also reported to have done considerable damage.

Economic Entomology in India.—The "Indian Museum Notes" issued by the Trustees of the Indian Museum at Calcutta, and which are devoted almost entirely to the subject of economic entomology, have been frequently noticed in INSECT LIFE. We have recently received No. 6, vol. II, and Nos. 1 and 2, vol. III, which contain the usual amount of interesting and well illustrated entomological articles. An important summary of the injurious insects of India is published in No. 6, vol. II. The insects are arranged according to scientific classification and the list contains 240 species. No. 1, vol. III, is a large number and contains a great variety of interesting notes, most of which are under the head of "Miscellaneous Notes." Lack of space precludes any extensive notice, and, in fact, most of the species treated are not found in this country. The Cheroot Weevil, an insect congeneric and of similar habits with our Cigarette Beetle, does much damage to India cheroots. The remedies consist in subjecting the cheroots to a temperature of 80° or 90° C., but since this injures the flavor of the tobacco, the means which we have urged in this country of destroying all refuse tobacco and keeping the leaves to be used in tight receptacles over night, are urged by Mr. Cotes. A great deal is said about injurious locusts, particularly about *Acridium peregrinum*, and an interesting account is given of an egg-parasite of the latter insect which Mr. Bigot has named *Anthomyia peshawarensis*. No. 2 of the same volume is

largely devoted to a consideration of the locust invasion of 1889–'92, and the history is interesting largely on account of the enormous numbers of locusts which were destroyed by hand for the Government bonus. In some of the villages it was not unusual for 10,000 people to be at this work at once. Eggs were destroyed to the amount of 50,000 pounds in some districts, while the locusts themselves were killed in such enormous numbers that in a single district, that of Jhang, 1,500,000 pounds were destroyed.

Technical Entomology at the Ohio Station..—Vol. I, No. 3, of the technical series of the bulletins of the Ohio Agricultural Experiment Station, published April, 1893, is devoted to entomological and botanical papers. Mr. F. M. Webster, Entomologist to the station, contributes an article upon "Methods of Oviposition in the Tipulidæ;" one on "A Dipterous Gallmaker and its Associates" (the gallmaker being described by Mr. John Martin as *Lasioptera muhlenberghiæ*); and some general notes upon some species of Ohio Hymenoptera and Diptera heretofore undescribed. The Hymenopterous insects are described in a supplementary article by Mr. W. H. Ashmead. We have seen two editions of this bulletin, one published with a cover and with the plates separately printed upon good paper, while the other has the customary form.

Virginia Station, Bulletin 1, New Series.—Various common injurious insects, with remedial measures for the same, are discussed by Prof. William B. Alwood in No. 1, vol. II, new series, of the Virginia Agricultural Experiment Station (Bulletin 24, January, 1892). The matter is elementary in character, dealing with well-known common insects, and includes also general directions for the preparation and application of the more important insecticides. Similar matter relating to fungus diseases and fungicides is also included.

Colorado Station, Bulletin 24.—Prof. C. P. Gillette, in Bulletin 24 of the Colorado Station, July, 1893, presents a similar publication, dealing, however, with garden pests, such as the Cabbage Worm, Flea-beetles, and Onion Thrips. An account, with a new figure, is given of the Two-striped Flea-beetle (*Systena tæniata* Say), which is generally injurious to garden vegetables other than Cucurbitaceæ in Prof. Gillette's experience, and some valuable notes on an Onion Thrips which has been very injurious the present season in Colorado, and which, from specimens sent us, was determined by Mr. Pergande as probably *Thrips striatus*, but which Prof. Gillette thinks, from certain characters which he figures, may be a distinct species. Should this prove to be the case, he proposes

for it the name *Limothrips allii.* Remedies for all the insects are given, that for the Onion Thrips being kerosene emulsion in the usual proportions thrown forcibly upon the plants, care being taken to thoroughly wet the axils of the leaves where the young congregate. He advises making the application in the evening or the early morning, when the mature forms are more sluggish than in the heat of the day.

Alabama Station, Bulletin 45.—Bulletin 45 of the Alabama Station (June, 1893), by Prof. J. M. Stedman, is still another republication of well-known facts about common insects and remedies, and will serve a very useful purpose in furnishing the farmers of Alabama with data for the recognition and treatment of insects which, from lack of circulation of older publications, have not been accessible to them hitherto.

Imported Beneficial Insects.—We have had little to say in INSECT LIFE as to the results of Mr. Koebele's last mission to Australia and the status of the imported insects, though we have endeavored to record every fact of importance connected with these insects. As the mission was undertaken under the joint auspices of the State Board of Horticulture and this Department, we recently instructed Messrs. Coquillett and Koebele to make a thorough examination of the colonies of imported insects, and report. It will be noticed from their reports, published in this number, that the insects from which the best results were expected, as indicated in previous numbers of INSECT LIFE (viz, *Orcus chalybeus* and *O. australasiæ*), seem to have increased at but one of the points at which they were colonized, and even here very slowly, while another species, of which little has been said hitherto, namely, *Rhizobius ventralis*, was found by Mr. Koebele to have multiplied in a remarkable manner at Santa Barbara.

We also publish a somewhat extended review of Dr. H. Rouzaud's important paper upon the life history of *Erastria scitula*, a European Lepidopterous enemy of the Black Scale, *Lecanium oleæ*. This insect we hope to import into this country in the near future, as, from all that can be gathered, it keeps the Black Scale effectually in check in parts of Southern Europe which, in climate, agree fairly well with that of Southern California.

AN IMPORTANT PREDATORY INSECT.

(*Erastria scitula* Rambur.)

An interesting paper upon the habits and metamorphoses of a predaceous Lepidopter destructive to Bark-lice has just been published by Dr. H. Rouzaud, of Montpellier, France. This insect, which is a small Noctuid moth, was carefully studied by Dr. Rouzaud during 1891 and 1892, and it has been ascertained that it is a very important factor in the life history of the Black Scale of the Olive, *Lecanium oleæ* Bernard, and of several allied Coccidæ. Although described sixty years ago by Rambur, the species has been little studied. The larva was unknown until Millière in 1875 published a statement that he had received specimens from Himmighoffen, of Barcelona, each of which

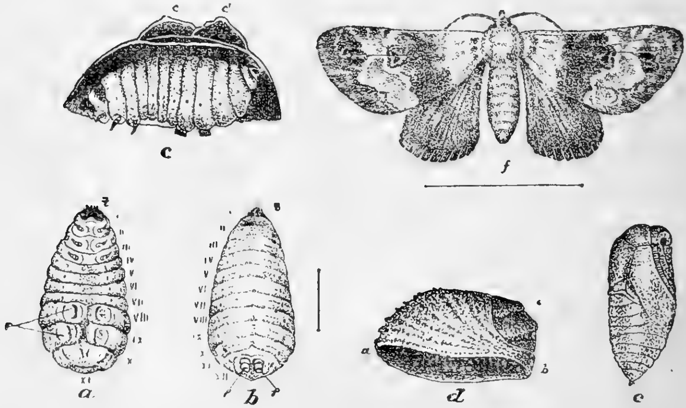

FIG. 1.—*Erastria scitula; a*, larva from below; *b*, same from above; *c*, above, in case; *d*, case of full-grown larva; *e*, pupa; *f*, moth—enlarged (after Rouzaud).

carried a sort of convex carapace or papyraceous envelope which served as a dwelling place, and in which it transformed. In 1884 the same author, upon the authority of Peragallo the elder, showed that the larva is predatory, feeding upon Coccidæ upon the Peach and plants of the genus Nerium, on the shores of the Mediterranean. The extraordinary form of the larva is mentioned, and it is compared, properly enough, with that of *Thalpochares communimacula*. The description, however, was not exact, as Rouzaud points out.

Rouzaud had been engaged in studying *Lecanium oleæ* for some years, and in June, 1891, observed an adult of Erastria ovipositing upon the

Coccids, and obtained some forty or more larvæ which he transported to the laboratory and watched in confinement. Struck by the enormous destruction of Coccidæ by these larvæ, he followed their transformations carefully throughout the season of 1892 and discovered five successive annual generations. The first appearance of the adults, few in number, occurred about the middle of May; the second, moderately numerous, towards the third week in June; the third, very abundant, about the middle of July; the fourth, equally abundant, about the end of August; and the fifth, again few in numbers, towards the end of September and during the early part of October. The falling off in numbers of the last generation is largely accounted for by the lack of food. The larvæ feed only upon large Bark-lice, those females which are full-grown or nearly full-grown, and such individuals occur most numerously in June, July, and August. Except during these three months, the only individuals at all abundant are of inferior size and retarded through poor nourishment. The falling-off in the number of moths in October results, then, from the fact that the September larvæ have not been able to find enough large Coccidæ.

The adult insects of both sexes resemble each other closely, and both afford a striking example of protective resemblance, simulating in repose sparrow droppings. The moths issue at the close of the day, and upon emerging from the cocoon are extremely active. Whatever the position of the cocoon, whether upon the leaves, branches, trunk, or base of the tree, the moths drop immediately to the ground after emergence from the cocoon. They jump, roll over on the back, and vibrate the wing pads actively for forty seconds and finally become perfectly motionless. Three or four minutes after birth their wings become expanded, and they fly up among the leaves and branches of the tree from which they have previously fallen. During daylight the moths remain motionless, the wings held close to the body, in which attitude, on account of their size, coloration, and general aspect, they bear the close resemblance just mentioned to the excrement of small birds. Copulation, which is of short duration, always takes place at night, the period during which the moths are active. The males live only one or two nights, in all probability, while the females in captivity live ten or twelve days at the least. Egg laying lasts several days, and each female produces about a hundred. These are deposited one at a time and each is separated from the other by a large interval of space. The female scatters them by preference upon the leaves or the young buds, although they are often laid directly upon the back of the Bark-louse.

The young larva at once enters its host, devouring all the internal organs, leaving only the dorsal carapace, which is more or less thick and hard. A Coccid which has been attacked always shows at some point or other on the dorsal surface an opening by which the predatory larva has entered. The young larvæ are of a red-wine color, except the head, which is brown, and this coloration lasts until

just before the transformation to chrysalis. At the time of the transformation, however, a bluish-white color is assumed. Although the size of the younger larvæ is not greater than that of the Bark-lice which they attack, they spin no silk at first and the spinnerets are rudimentary. As soon as the contents of one Bark-louse have been devoured the caterpillar abandons it and seeks a new prey, and is sometimes found exposed upon the twigs. Apparently realizing the necessity for protection, as well as additional food, it hastens to bury itself in a new victim, which usually is a matter of but some minutes. After having entered a Bark-louse it seems to be effectually protected from parasites. After ten days, and after having passed through several molts, the exact number of which has not been observed, the larva begins to construct a silken covering spun from the spinnerets, which make their appearance only at this late stage. This covering enlarges the case formed by the coccid shell and to it are attached excrement and the débris of the Coccidæ. This artificial case the larva now carries about with it, during its final stage. It has left an opening for the head and feet, and in fact for the larger part of its ventral surface and crawls about, devouring several Coccidæ every day. The covering is held in place by the anal prolegs, two pairs of abdominal prolegs being functional. As the larva continues its destructive work it is with difficulty perceived. Hidden in this case, which it never leaves, and from the anterior of which only the head, which is coriaceous, small, and blackish, issues, it is very difficult to distinguish it upon a surface covered with smut fungus, as twigs infested by black scale usually are. The efficacy of this protection is indicated by the fact that, although several hundreds of cocoons of Erastria were obtained by M. Rouzaud, upon only one occasion did parasites emerge instead of the moth. In this instance 50 small Chalcidids were reared, and so far as he is able to judge, the species is identical with one which he reared from a Coccinellid (*Exochomus quadripustulatus*). In this statement, however, we are inclined to think that M. Rouzaud is mistaken.

Upon arriving at full growth the larval case has become enlarged far beyond the dimensions of the original Bark-louse, which in fact now occupies a superior position on the anterior end of the case. The case has been built out with silk, excrement, and the fragments of eaten bark-lice to a distance of perhaps four times the length of the full grown Lecanium and nearly three times its height. The larva then searches for a favorable position in which to fasten its case, prepare its cocoon, and transform to pupa. It chooses a leaf very rarely and is more often found in the angle formed by two branches, or in large crevices in the bark of the trunk. Perhaps most frequently it is at the collar of the trunk, where the bark is roughest, that the cocoon is found. The cocoon is formed by increasing the silk layer and completing it beneath the larva, first clearing the surface upon which it is to be fastened by means of the mandibles. Five or six cocoons are sometimes found together on the

upper part of the trunk, but at the collar they occur by hundreds, so that they are frequently fastened one upon another. Two-thirds of the completed cocoon is formed by the larval case, the remainder being composed of new silk spun for the purpose. Before transforming, however, the larva prepares a point of exit for the future moth by gnawing nearly through the wall of the cocoon at the point nearest the old place of exit of its head from the larval case.

In concluding his summary of the life history of the species, M. Rouzaud devotes some attention to the possibility of transporting the insect from one place to another. The half-grown larvæ are able to support a journey of eight days without nourishment. They will not destroy each other, as is the case with other carnivorous larvæ, but content themselves with gnawing the stopper which incompletely closes the tube and permits the access of the air. Upon their arrival they need only be placed upon plants infested with Coccidæ. During the entire summer it will be easier to send the larvæ in this way. Cocoons containing full-grown larvæ or chrysalides can also be transported in the same way, and will stand a journey of eight or ten days in midsummer. In this case, however, it is best to wrap a few well-stocked twigs with gauze and inclose the cocoons in the center. If the moths emerge, they will couple and deposit their eggs on the journey. It is then only necessary to attach the twigs to those of infested trees. In the winter time it is easy to send the cocoons or eggs a long distance, and there is no reason why Erastria can not be acclimatized in Australia, California, and Cape Colony.

In discussing the conditions under which Erastria may be efficaciously employed against *Lecanium oleæ*, there is one point of prime importance to be observed, says M. Rouzaud:

It will be necessary to have at hand a sufficient number of young larvæ (that is to say, of larvæ which have a tolerably long life before them), and many Bark-lice for them to devour; to satisfy the first condition I see no way but to breed the larvæ on a large scale. With this end in view, it would be possible to raise early larvæ in a greenhouse on bushes more advanced than those out of doors, and subsequently to carry these larvæ to an infested plant. It might even be possible to discover an animal nourishment which would suffice for a sort of artificial feeding of the young larvæ. I believe that oleanders suitably forced towards the end of the winter and well stocked the preceding summer with young *Lecanium oleæ* could be readily used in the production of early larvæ of Erastria on a large scale. But I also believe that a true artificial food may be found for them, easier to produce and distribute than living prey. In either case, of course, everything is yet to be done and the field is open for research; the end to be attained seems to me worthy of the most skillful experimenters. Admitting that a sufficient quantity of the larvæ are at hand, and that the problem of rearing them on a large scale has been solved, a second very important point to be observed is, that they shall be put to work at the right moment, say just before the eggs are laid by the Bark-lice, or at least before the issuance and spread of the young.

In sending us copies of the important paper which we have thus reviewed, M. Rouzaud has kindly offered to transport to this country

for experimental purposes, living specimens of this extremely valuable insect, and we have arranged to accept his kind offer to attempt the introduction of the species into California upon a somewhat extensive scale. Up to the present time *Lecanium oleæ* has not been found elsewhere in this country, except rarely in greenhouses, but it is extremely abundant in California, not only upon the Olive but also upon Citrus trees. It can hardly be considered one of the most destructive of the California scale-insects, but it is a very injurious insect and damages trees not only by its own excessive multiplication, but by the extraordinary quantity of smut which follows its appearance, due undoubtedly to its copious secretion of honey dew. Although the Black Scale possesses in California as well as in Hawaii an efficacious parasite in *Dilophogaster californica*, the latter does not breed rapidly and seems to have but two annual generations. Occasionally this Chalcidid reaches a point where it destroys from 75 to 90 per cent of the Black Scale upon a given tree, but such an occurrence is always followed by a rapid restocking with the scales, and the benefit is by no means permanent. In Erastria we have a much more rapid breeder, and if it should accommodate itself to the somewhat changed climate, as we anticipate, its introduction will prove a boon to the California fruit-grower. In discussing different methods of importing the insect, M. Rouzaud has overlooked, as it seems to us, the fact that it will be dangerous to bring it over in any condition except the egg. Although parasites seem scarce, the known existence of one indicates the possibility that at any time an infested larva or chrysalis may be brought over and in some degree vitiate the success of the experiment. Even at this early date M. Rouzaud deserves the gratitude of our fruit-growers for his public-spirited proposition.

Other things being equal, the Erastria will prove a most profitable insect to introduce into California for work against the Black Scale. It comes from the native home of the scale insect and is there an effective enemy of the species. The Dilophogaster above mentioned is not European, and has this disadvantage in addition to that of slow breeding. On another page of this number of INSECT LIFE is mentioned, on the authority of Mr. Koebele, the effective work of *Rhizobius ventralis*, on the Citrus trees infested with Black Scale in a grove belonging to Mr. Elwood Cooper, at Santa Barbara. This is one of the lady-birds sent over by Mr. Koebele during the late expedition to Australia and it has been extensively disseminated. If it continues to work as effectively as reported from Santa Barbara, the necessity for the introduction of the Erastria may cease, though no harm can result from the latter's introduction, and there are some reasons for concluding that it will prove the more effective of the two.

NOTES ON TASMANIAN COCCINELLIDÆ.

By E. H. Thompson, *Tasmania.*

Your many kindnesses in sending the very valuable publications of your Department make me venture to address a few lines to you on the subject of our Coccinellidæ, the more so as some attention was drawn to them by Prof. Webster in Insect Life, vol. II, p. 287. Although I do not for a moment pretend that all our Tasmanian species have been discovered (more than half of the island is still a *terra ignota*, and covered with impenetrable scrub), still I think that as far as the inhabited portions of the Colony are concerned there are not likely to be many more Coccinellids at work, as I have traveled through the length and breadth of it during the last eighteen months and have specially kept my eyes open for Lady-birds and other friendly insects. I place *Leis* (or, according to Masters's Catalogue of Australian Coleoptera, *Coccinella*) *conformis* Boisd., as first in the list. Not only is this beetle the most numerous, but certainly the most useful. I have found it preying on the *Icerya purchasi* (which it completely kept down or cleared out entirely), on the Mussel Scale (*Mytilaspis pomorum*), *Schizoneura lanigera*, *Aphis brassicæ*, *Aphis rosæ*, *Rhopalosiphum* sp., and also on the different scales attacking our Peppermint and ordinary Eucalyptus. The larvæ are large in proportion to the size of the imagines, and are black with two yellowish orange bands at second and third molt, finally attaining two more colored bands. When first hatched they are quite black.

I have reasons for believing that the larvæ of Leis and of the small black Scymnus are both subject to parasitic attacks, but so far I have not been able to secure the culprit. The next Lady-bird as regards usefulness and activity is *Cleodora mellyi* Mulsant, so named for me by Mr. George Masters, of the Macleay Museum, Sydney, New South Wales. This is a comparatively unknown Coccinellid in Australia, as it was not recognized by several experts to whom I showed it. I just discovered it last year at Devonport, on the northwest coast of Tasmania; since that I have found it in the South. I can always secure many more larvæ and eggs than I can of the perfect beetle. It is very active and flies at the least disturbance. It so far seems to be confined to small Eucalypts, which are covered with *Eriococcus eucalypti* Cr., and other similar scales. The larvæ are much broader than those of Leis, and instead of having continuous bands of yellow, have a series of pale yellow dots on eight segments arranged somewhat regularly. The imago is a very large Lady-bird, and the elytra are very much pointed. Commencing from the two "comma"-shaped markings, there is a distinct carination which extends along the anterior margin to the next series of markings. From its size and rapacity this Lady-bird must do a vast amount of good, but I have never yet found it working on economic plants or trees. The fourth insect is much smaller than *Leis*

conformis, and is, I believe, undoubtedly *Coccinella repanda* Thunberg, though I do not find it catalogued under that name by Mr. Masters. This Lady-bird is generally associated with Leis in its attacks on *Mytilaspis pomorum*, and in one or two places in the south of the island, they have, unaided, completely stamped out the scale. They make a small round hole in the top of the scale and devour the eggs. This last year (1892) I found the gardens about Brighton, in the midlands, perfectly alive with the larvæ of these two Lady-birds, but I could discover but little for them to feed upon except the Rose Aphis. Perhaps I visited the district too late, and their work was done. The third Lady-bird I have only found in one part of the island, Scottsdale. It is described by the Rev. Mr. Blackburn, of South Australia, as *Verania frenata* Erich. (*Alesia frenata* Erich., according to Masters's Catalogue) I found this Lady-bird only in its perfect form: I hunted well about for larvæ, but I could not discover them. It was feeding ravenously on the Woolly Blight (*Schizoneura lanigera*). The fifth Coccinellid puzzles me. On examining the specimens in the Sydney Museums I find that there is a very marked difference in the appearance of the Australian and Tasmanian specimens. Here they are, with the exception of the six orange spots, of a uniform lustrous blue-black metallic color, while the Australian specimens show gradations of shade and color as shown in Fig. 1, Pl. IX, p. 67, vol. II, part 2, of the New South Wales Agricultural Gazette, 1891. I do not pretend to say without further information, but I am inclined to think they must be different. Two black Scymni are extremely common in places under the loose bark of Eucalypts. I seldom found them on economic plants. Owing to the elongated compressed shape of the first of these I was at first almost inclined to think that I must be mistaken and that it was a phytophagous insect, a Paropes, for instance, but on examination I find that it is undoubtedly a Coccinellid. It is only sparsely pubescent, while the other one is largely so. The last four or five segments of the abdomen are of a distinctly yellowish brown or fulvous color. It is hemispherical and at times very small indeed, though possibly there may be different species. I shall be glad to send you specimens of any or all of these insects if they would prove interesting to you.

EXPERIMENTS WITH THE HOP LOUSE IN OREGON AND WASHINGTON.

(Report of an investigation made under instructions from the Entomologist.)

By ALBERT KOEBELE.

I arrived at Portland, Oregon, April 19 and visited Prof. F. L. Washburn at the Experiment Station at Corvallis, Oregon, who has had this insect under observation for some time and who has published valuable

information in Bulletins 10 and 25, of his station, both as to the life history and known remedies. Mr. Washburn kindly advised me as to the best locality in which to carry on the experiments and also furnished me with a list of hop-growers. Aurora was selected as a central point for operations. The season was very backward when I arrived there on the 26th, the plum trees only just coming into blossom, and for the preceding five weeks there had been more or less rain daily.

The most important point was to ascertain if other plants or trees than Plum and Prune existed upon which the winter eggs are deposited, and all plants were consequently examined during the whole time of my work up to June 25. In no instance could the lice be found on any other than the plants mentioned. A Phorodon feeding upon mint is without doubt a distinct species, as it could not be induced to feed upon the hop vines, and its migrant has been observed to leave its offspring upon the mint.

With the exception of seedling plums, upon which the stem mother was found, no other wild plums were met with, and upon all the wild cherries examined, both in Oregon and Washington, no trace of the Hop Louse could be found. It was not until May 12 that the first colonies of *Phorodon humuli* were met with upon various plum and prune trees, the stem mothers with their offspring chiefly, yet in some instances young of the third generation. As late as May 23 stem mothers with but few young were found, and on May 26 the first winged migrant was observed. With the beginning of June the winged insects could be found almost anywhere, yet not in large numbers, and a week later the young of this generation could be found occasionally upon the hop vines. This has been an unusually late season, and in ordinary years the lice may be expected to appear upon the vines about three weeks earlier.

The Hop Louse has been, generally speaking, not numerous, while the predaceous insects have been very abundant, so much so that in the early spring in some of the yards before they were plowed, from fifty to seventy-five lady-birds could be counted to every hill. These were attacking two species of Aphidids, which occurred on weeds, and to some extent on the hop vines, which they speedily cleared of lice and had to leave in search of food elsewhere. The more numerous of these lady-birds, numbered 8, 4, 5, 3, 2, 7, 11, and 14, following the order of their abundance, I have forwarded for determination.* No. 14 was always present whenever hop lice occurred. Many of the colonies of Phorodon under observation upon plum trees were entirely destroyed by these lady-birds, and chiefly by No. 8, which is a most active little insect. Other predaceous insects, such as Syrphidæ and Chrysopa, were also present in large numbers, and on one occasion upon plums. A

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* The Coccinellids sent by Mr. Koebele represent the following species: 8, *Adalia frigida*, var. *barda*; 4, *Hippodamia spuria*; 5, *H. parenthesis*; 3, *H. 13-maculata*; 2, *Coccinella transversoguttata* and its var., *transversalia*; 7, *Harmonia 14-guttata*, var. *cardisce*; 11, *H. 12-maculata*; 14, *Scymnus nebulosus*.—Eds.

Braconid was observed to oviposit in the second generation of *Phorodon humuli*. The parasitic insect could not be obtained, nor could any parasitised lice be found later, as all were eaten up by Coccinellidæ. It is quite natural that these valuable predaceous insects should increase to such an extent with the appearance of the Hop Louse in Oregon and Washington, and last year also the lice were kept in check to some extent, and only in certain yards was serious damage done. From all appearances it is hardly likely that the hop louse will do serious injury the present summer.

Whether the only true parasite of the ladybirds known here as *Euphorus sculptus* Cr. will ever become numerous enough to reduce the vast numbers of Coccinellidæ is, in my opinion, rather doubtful. I have bred this parasite from the following species found in Oregon and Washington: Nos. 4, *Hippodamia spuria;* 5, *H. parenthesis*; 6, *Coccinella julians;* 8, *Adalia frigida.* Owing to the backward season the other predaceous insect enemies of the Hop Louse could not be obtained. It may be said, however, that the species of Syrphids living thereon will prove to be many.

REMEDIES.

As requested, I have tried the more effective remedies recommended in your report of 1888 as far as was possible upon the few Phorodon found upon plums and prunes. No experiments could be made upon the hop vines, as up to the end of June but few lice appeared on them, and it was only where the Phorodon were taken from the plum trees and placed upon the hop vines that a few tests could be made. The results obtained were essentially the same as stated by Mr. Alwood.

Kerosene Emulsion.—This was prepared as in Mr. Alwood's experiments: Oil, 8 pints; water, 4 pints; soap, one-half pound. It was used on Phorodon, on plum and hop vines, diluted twenty-five times, and the results were not quite as satisfactory as could be wished, the wash settling in drops and leaving some marks upon the leaves, while many of the lice escaped being killed. The emulsion prepared with 1 pound of soap and sprayed upon prunes gave no better results. An emulsion prepared with 1 gallon of kerosene, 2 gallons of resin compound and diluted to 75 gallons of wash did not work satisfactorily, as it would not spread as well as fish-oil, soap, or resin compound, and also left marks upon the leaves of hop vines treated. This latter emulsion is very easy to prepare, and its cost is about 18 cents for the 75 gallons.

Soap No. 1.—This is Alwood's formula, yet instead of using Leon Hirsh's crystal potash lye, Babbitt's potash lye was used, as the first-named article could not be obtained. The soap is indeed an effective agent against Aphides, and, as far as the cost and efficiency are concerned, is one of our best remedies. Babbitt's potash lye, 1 pound; fish oil, 3 pints; soft water, 2 gallons. The lye is dissolved in the water and when brought to the boiling point the oil is added and the

batch should be boiled about two hours. When done, if filled to make up the evaporation by boiling, there will be about twenty-five pounds of soap, enough for 150 gallons of effective wash, and costing about 23 cents.

Soap No. 2.—Babbitt's potash lye, 2 pounds; fish oil, 6 pints. The lye is dissolved in four gallons of water, the oil added, and boiled for about two hours. After the soap is complete a decoction of 2 pounds of tobacco stems is worked in. This makes about 40 pounds of soap and, diluted with 400 gallons of water, will make an effective wash, the cost of which is about 50 cents.

Soap No. 3.—This is a resin soap made with 4 pounds of resin, 2 pounds of tallow, and 1 pound of Babbitt's potash lye. It made 20 pounds of good hard soap and was used at various strengths, yet did not work satisfactorily, compared with other washes, and it is not recommended.

Resin Compound.—It is to be regretted that this valuable insecticide for soft-bodied Coccidæ and all Aphididæ has been so neglected as a means against the Hop Phorodon. I have, on former occasions, recommended this insecticide as the best for destroying this insect, and have not as yet come to any other conclusion. It is certainly one of the simplest washes to prepare, and a failure in producing a properly saponified resin brings no bad consequence to plants, and at the most affects only the operator's temper by constantly clogging up the nozzle. Three pounds of common washing soda (carbonate of soda) will dissolve four pounds of resin. One pound of caustic soda, about 76 per cent strong, will dissolve 6 pounds of resin effectually, but not more. In dissolving the carbonate of soda, water only should be added. The broken up resin in a kettle, covered with this solution, should be boiled thoroughly until the resin is well dissolved, not leaving any soft lumps which will not dissolve later. Hot water should be added while boiling or cold water in small quantities to make about five gallons of compound. This, before cooling, should be diluted with cold water.

One pound of caustic soda is dissolved in 2 gallons of water and 6 pounds of broken resin are boiled with about 3 quarts of the lye. After being well dissolved the rest of the lye is added slowly with water to make about 8 gallons of compound, which should be diluted with water before cooling. In preparing the resin compound it is important to secure a resulting clear, brown mixture, at which stage it is ready to be diluted with water. A milky appearance indicates an imperfectly saponified resin. Resin is sold at Portland at $4 per barrel of 280 pounds. Six pounds of saponified resin, as given above, will cost about 17 cents and will make 75 gallons of a strong wash. If diluted to 100 gallons it will still be very effective—in fact, rather better—since the various insects preying upon the Aphidids are not destroyed by a wash of this strength.

The action of resin wash upon Aphididæ is immediate. After being

sprayed they raise their honey tubes and remain in this attitude in all dead specimens. The wash can be used at any time and upon any plants with safety at 1 pound saponified resin in 12 or 15 gallons of water, and even stronger.

I have used 1 part of compound to 20 parts of water with some tobacco decoction and it still spread well and destroyed the Phorodon. Resin compound, 1 pint; tobacco water (1 pound of tobacco stems boiled to 4 gallons decoction), one-half pint; water, 14 pints. This destroyed all the lice, yet I am not prepared to say what effect it will have upon the predaceous insects living upon them.

As a penetrating and adherent basis for any insecticide or fungicide, resin compound stands at the head.

Quassia and soap No. 1.—This is the same as given by Mr. Alwood, as follows: Quassia, 6 pounds; soap, 3 pounds; water, 100 gallons. This was sprayed on Phorodon upon prunes at various points and the result was not satisfactory. The numerous ants attending the Aphidids were not destroyed by this wash, and they carried off all the lice not destroyed by the application the following day, leaving the immature lice dead upon the leaves. The action of the quassia is very slow and considerable time elapses before the lice are all destroyed. Quassia, 1 pound; soap No. 1, one pound; water 22 gallons, gave results similar to the above. These washes do not spread so well as the fish oil and resin washes, and many lice escape in consequence. They furnish, however, a fairly good remedy, but the quassia chips are somewhat expensive, being sold here last year, I am informed, at 10 cents per pound, retail price. The present season the price is 6 cents per pound. While in Oregon I met with an English gentleman who is also selling quassia chips in England at a price less than 2 cents per pound, and he assured me that he is deriving a profit of 35 per cent, and I have been informed from various sources that dealing in quassia in this country is a very profitable business. As employed at present, 8 pounds of quassia and 6 pounds of whale-oil soap are used in 100 gallons of water, the ingredients costing something like 96 cents.

Sapocarbol.—This is a highly spoken of German remedy against various Coccidæ and Aphididæ, and is in use against the Hop Louse. Mr. Kola Neis, of Springfield, Oregon, received a sample from the manufacturers and I had opportunity to test it. The article is diluted to from one-half to 3 per cent strength with water. It was used upon Phorodon upon prune first at 2 per cent strength. This spread well and killed every louse, yet burned the leaves badly. At 1 per cent the wash was still soapy, spread well, and killed all the lice, yet left marks on the leaves where the lice were thickest. The substance is a good insecticide, but costs too much for popular use, being sold at the factory in Eisenbüttel at 80 marks per 100 kilograms.

In the spring, from two to three weeks after the appearance of the leaves on Plum and Prune upon terminal twigs, the stem mothers

with their offspring can be seen in clusters, and it is at this time very easy to destroy them by spraying, or even better, by hand-picking, which method I consider the best. I have myself gone over a Plum and Prune orchard twice, and was able to gather all the Phorodon present in a very short time. Mr. H. J. Miller, of Aurora, Oregon, at my request, kindly consented to collect all the lice upon his trees by going over his orchard three times at weekly intervals, and succeeded remarkably well in cleaning them entirely of Phorodon, and this simply by hand-picking. To kill the lice a kerosene-oil can was used filled about half with water and with 1 quart of kerosene, into which the branches with lice were immersed. I am confident that if, at this season, a united war were made against the Phorodon very few would ever reach the hop yards. A strong kerosene emulsion as a spray applied to Plum and Prune trees in the autumn and winter would destroy most of the eggs, and hand-picking or spraying in spring would almost, if not wholly, prevent these insects from migrating to the hop yards.

REPORT ON OUTBREAKS OF THE WESTERN CRICKET AND OF CERTAIN LOCUSTS IN IDAHO.

(Report of an investigation made under instructions from the Entomologist.)

By ROBERT MILLIKEN.

Owing to the shortness of the period in which I was enabled to give attention to the work, and other matters requiring a part of my attention, I have been able to attend only to the distribution and general characters of the insects under consideration, and could not investigate in detail as I would have been pleased to have done.

I have been able to learn of but two areas in the State in which locusts have caused any serious loss of crops, one being the valley of Boise River in Ada and Canyon counties, extending from a few miles below Boise city to the confluence of the Boise with Snake River, and the other the Big Lost River Valley in the eastern part of Custer and Alturas counties in eastern Idaho.

I made two visits to the Boise Valley, the first one the 24th of July, 1893, and found locusts doing much damage in places, but not uniformly distributed over the valley, being, in places, abundant enough to ruin oat fields and the second crops of clover and alfalfa, and being particularly destructive to young orchards and gardens along the edges of the valley. Much interest is being manifested in this part of the State lately in fruit culture, and many orchards of Prunes, Peaches, and other fruits are being set out, and the locusts have, in many cases,

caused much damage by eating the foliage as fast as it grows on the young trees. I found cases when it became necessary to cut fields of oats green and convert the crop into hay, the hoppers having taken the blades and heads from a good part of the crop on the borders of the fields. They did not appear in sufficient numbers early enough to materially injure the first cutting of alfalfa and clover, of which large quantities are produced, more than to denude the stalks of a part of the foliage, but I saw fields cut early in which the hoppers kept ahead of the second crop notwithstanding free and careful irrigation, so that the fields were as brown and bare on the 7th of August as they had been the 1st of July, when the first crop was removed and stacked

From the best information obtainable I could not learn that these locusts were from swarms invading this region from any outside territory, but were of the nonmigratory species which breed from year to year in the valley.

The Boise River takes its origin in the mountains of central Idaho, entering the Snake River Plains about 10 or 12 miles above Boise City through a canyon, and takes a course nearly westward along the low foothills flanking the higher mountains of the central plateau of the State for a distance of 25 to 30 miles, when it makes a detour towards the west across the plains, entering Snake River about 50 miles from its effluence from the mountains.

These foothills rising gradually from the edge of the great arid Snake River Plains to an elevation of from 200 to 2,000 feet have from time immemorial been the favorite hatching ground of a number of species of locusts which frequently become so numerous that they overrun the adjacent valleys and cause great destruction to the crops of the "rancher" who may be so unfortunate as to be in their path. Settlers have been in this valley now for about thirty years, and it appears that periodically the locusts invade their farms for a time and then disappear for seven or eight years and then increase again.

Some of the more imaginative ones have conceived the theory that the locusts are, like the cicadas, periodic, and that the eggs lie in the ground for a certain period of about eight or nine years, when they hatch in great number, again, after a certain time, to deposit eggs and disappear as before. It has taken considerable argument to convince them that this is not the true theory of the periodic invasion.

It seems that both locusts and crickets have the same periodic character, following each other closely in their time of appearance, flourishing for a few seasons and then nearly disappearing, the periods of frequency being about ten years, 1872, 1883, and the present year being notably years of abundance.

I have been unable to learn of any well authenticated flights of locusts into this valley from other sections, although there are traditions and rumors of such, but whence, I could get no definite information, though more intelligent persons with whom I talked told me that they hatch in

the foothills adjacent to the valley, and are to be found in these places at all times, and periodically overrun the valley.

What the extent of this invasion will be is, of course, problematical. This is the third season in which they have been increasing perceptibly and doing damage in the valley, getting more and more numerous and doing greater injury each year, and extending over more of the cultivated part of the valley as they increase. If the increase next year should be in proportion to that of the last two years, great loss of crops will occur along the valley of the Boise River and for some distance out on the plains, where much territory has recently been brought under cultivation by the construction of irrigation ditches.

There are several species of locusts to be found in the infested fields, but the greater number are referred to *Camnula pellucida* (*C. atrox?*) *Caloptenus bivittatus*, and *C. atlanis*, with a smaller number of *C. devastator* and *C. cinereus*, and quite a sprinkling of *Dissosteira longipennis* and *D. carolina*.

One thing that seemed remarkable to me was the great diversity in ages and sizes of the insects, which did not seem to be confined to any particular species exclusively, ranging from larvæ scarcely a day old to full-fledged insects, in many cases pairing preparatory to egg laying for a new brood.

I was unable to learn in the limited time at my disposal that parasites or diseases were prevalent to any considerable degree, further than that the red mite was to be found on quite a number of specimens, and that a few were dying from some apparent fungus attack, but I could not determine its nature.

The affected insect would attach itself firmly to a stalk of grain or grass, so firmly that it could not readily be removed entire, and turn to a dark leaden hue, the whole interior cavity of the body being filled with a semi-liquid mass, the tissues of the body being so destroyed that the insect would fall apart almost with its own weight, even before life was wholly extinct. This condition was observed at the time of my first visit, July 24, and seemed to affect quite a number of the insects, in which I could find nothing having the appearance of parasites.

At my second visit, August 7, no such diseased insects were to be found, but thousands of empty shells of their bodies were lying about, a dozen being common in the area of a single yard, but whether the contents of the bodies had been removed by some kind of parasite or death was the result of fungoid disease, I was unable to satisfactorily determine. It was evident the cause that was operating in the first instance had passed its season. I, however, found one case in which the body contained two larvæ of some kind of Tachina fly, but have no assurance that this caused the general destruction so prevalent throughout the field.

Egg laying had apparently not yet begun, but a number were seen in coition; in one case a pair were destroyed by the disease in that position, the empty bodies being together.

The other section in which the locusts are doing damage, as before described, lies in the eastern part of the State, in the mountains, and not contiguous to the plains as in the Boise Valley.

This region being far from the railroad, about 75 miles from the nearest point, I was unable to visit it, but was fortunate to meet a very intelligent gentleman, Mr. Alex. Burnett, of Antelope, in the Lost River Valley, who gave me very valuable information regarding the locust visitation in that region.

In the summer of 1891 the locusts came into the Big Lost River Valley by flight, coming chiefly from the southwest, presumably from the Camas prairie country to the west of Wood River. They laid eggs quite abundantly, both in 1891 and in 1892, so that they are completely denuding the farms in many parts of the valley from Arco to Huston. They have not yet acquired their full growth, but if they deposit eggs as generally as in the two past years, they will eat everything up in the entire valley. The kind is not determined, but Mr. Burnett will send specimens of the insects so that the species may be determined. They are presumed to be *Camnula pellucida* from description.

In neither locality has any effort been made to combat the destructive tendencies of the locusts, all trusting to natural causes to reduce the numbers as in the past. It will be interesting to note the condition in another season, when more time with better facilities for study and observation will be at my disposal for the purpose.

The people of Idaho give little attention to the locusts, as they are to a great extent local and much restricted in their ravages, but the Great Plains cricket, *Anabrus simplex*, is causing a good deal of consternation over quite an area of the middle portion of the Great Snake River Plains and the mountain region to the north, chiefly along Wood River and its tributary valleys.

Wood River is the only stream from Henrys Fork which takes its rise in Yellowstone National Park to find its way across the great lava plain of the Snake to that river, the others losing themselves in the lava beds to emerge as immense springs in the great canyon of the Snake. Wood River takes its rise in the great central plateau of Idaho and has a course nearly south of about 100 miles, and with its tributaries furnishes some of the finest agricultural lands in the country, as well as an immense area of the best mountain grazing lands in the northwest. Any disaster to the crops of this region will of course be a great misfortune.

The northern boundary of the plains of Snake River consists of an irregular crescent-shaped series of hills or low mountains, the outposts of the higher mountains lying to the north, and becoming so celebrated for their rich mines of gold and other metals.

In these foothills, along Wood River and for a distance of 50 to 60 miles to the westward, is where the crickets have this year become so numerous as to do a great deal of damage. They have been known to exist

for thirty years and more, and to hatch in limited quantities annually along the south side of these hills and on the edge of the adjacent plains, but never until this year have they become so numerous as to cause serious damage. This may be accounted for in two ways. First, they are like the locust, periodic in their increase and decrease, owing, presumably, to the effects of parasitic and other enemies, and, secondly, because since their last appearance in destructive numbers most of the land now in cultivation has been opened up to irrigation and farming.

The locusts, as found in 1891 by Prof. Lawrence Bruner, have almost wholly disappeared from this region. During a visit, July 30 to August 4, in Wood River Valley, I was able to find none to cause any alarm, only a few colonies of *Camnula pellucida*, and one noted for the bright blue of its legs, but which had not attained wings, and I was unable to determine its species, with scattered specimens of the usual residents, such as *C. bivittatus*, *C. atlanis*, and *Dissosteira obliterata* (?).

The locusts have vacated and the cricket has taken possession. They have been increasing noticeably for the past three years, each year working farther out upon the valley, and ovipositing wherever the season overtakes them, from the banks of Snake River to the tops of the mountains, 75 miles to the north.

I collected insects on May 14, at Taponis, on the Wood River, 16 miles west of Shoshone, scarce a day old, and learn that they have been abundant between Taponis and the river, having hatched at various points in the valley.

I learn that they hatched in considerable numbers on the top of the mountain lying east of the town of Hailey, close to the edge of the snow line, where the elevation is not less than 7,000 feet, as well as on other mountains to the west of Hailey and Bellevue.

I can not learn that they prevail to the east of the valley of the Little Wood River, which is one of the branches of Wood River, or that they extend to the west more than about 100 miles. The south branch of Boise River takes its rise in the mountains adjacent to the Wood River and has its upper course infested with the crickets. Great quantities were carried down the Boise River and, finding their way into the irrigating canals, were carried out onto the land in the country adjacent to Boise City, when they escaped by the millions and scattered over the land. So far as I can ascertain, they have all been destroyed which thus invaded the lower country before attaining their maturity.

The farthest to the west in this region in which they have bred this year is in the foothills at the head of Indian Creek, 5 miles to the northeast of Bisuka Station, or as it is now proposed to call it, Orchard Farms, on the Union Pacific Railroad, in township 3 east, and range 1 north, extending over to the headwaters of the Boise River.

I found no crickets more than 3 miles north or east of Hailey. The territory covered by them may be described as being covered by all of Ellmore County, the west half of Custer and Logan counties.

A small area is reported from the central part of Washington County, near Salubria, but to what extent they have been destructive I have not been able to learn.

A region known as Camas Prairie, lying to the west of Wood River in Alturas and Logan counties, seems to have suffered most. The permanent breeding grounds seem to lie 20 to 40 miles south of the Camas Prairie, and when they have become too numerous to support themselves in their usual haunts they strike out for pastures new, and it seems that this prairie got more than its share of the excess. D. C. Daugherty, of Soldier, writes me that—

Three years ago we had a very few in our locality on the prairie, a few more the following year, and this year millions, covering almost every portion of our beautiful valley—the larger portion of the same coming from pests that have been so numerous in the mountain range 20 to 40 miles south of the valley.

On a visit to Wood River, I had numerous reports verifying Mr. Daugherty's statement, and saw, from the foot of the mountains to Hailey, swarms of them, containing untold millions, devouring every green thing in their track. If there was nothing else for them to devour they would eat each other. It is not an uncommon sight to be able to count 20 clusters of insects where a half dozen or more had pounced on one of their number, and were proceeding to make a meal of him. It is a well-observed fact that whenever one gets disabled or injured in any way, his associates proceed to make a meal of him in short order.

Those which hatched on the south side of the mountains, especially if a little distance on the plains, when they were ready to migrate, took a south or southwest course, and by the first of August had nearly all crossed the Union Pacific Railroad and were well on the way toward Snake River. I was told by a farmer at Bisuka that they had then, July 21, been depositing eggs about his place, but the insects had passed on and wholly disappeared from the vicinity. Eggs were being deposited freely at Hailey August 2, and at Picawbo, 20 miles south, August 5, as observed by me personally.

I could see no signs of disease amongst them, nor parasites other than Red Mites; very abundant at Hailey, but few perceptible on those at Picawbo. A newspaper correspondent, writing to the Boise Statesman from Glenn's Ferry, reported the insects dying from some unknown disease. Also, Mr. Daugherty, above quoted, says:

At Fir Grove, 12 miles south of this point, and located at the south line of foothills, parties recently report that the crickets are dying off by millions from disease; and same report comes from points farther south.

I had not the opportunity nor time to investigate the truth of these reports. It occurred to me that possibly it might be that these were early swarms which had oviposited and were dying from natural causes; as to the south, where there was but little snow, they hatched a month or more before those in the mountains.

Many interesting and marvelous stories have been told of the crickets, how they fill up irrigating ditches, get into the flumes of mills, stopping the wheels with the mass of their bodies, and filling rivers, forming bridges so that the advancing army cross over safely on the dead bodies of their comrades, etc. I can readily believe them, for when their great size is taken into account, together with the countless millions in which they occur, and the well-known propensity to go straight ahead, turning neither to the right nor left, one can readily understand that an obstruction will soon take place if the advancing army keeps on its course. It is a standing joke that the crickets will not turn aside for a telegraph pole if it is in their path, but will go up one side and down the other to keep in the line of their journey. It is a well-known fact that a stream of water is no obstacle to their advancement, as they leap in when they come to it as if the stream were not there. In this way many perish. What another season has in store for the people of the infested sections of Idaho is a question fraught with great concern, and can be determined only by waiting patiently the outcome.

Eggs are being deposited over the entire area overrun by the hungry horde, from Snake River to the mountains, and if the increase in numbers in 1894 is in the same ratio as that of the two past seasons, there will not be a green thing left in the valley. As they travel at the rate of a mile a day they may overrun a considerable part of the adjacent territory before this time next year.

Laying their eggs as they do, in so many and in such inaccessible places, often on the tops of mountains, it is impracticable to apply any preventive measures to them in that stage. Since, as Mr. Daugherty, before quoted, says, "they show especial activity, good health, and bad morals," the prospect of being able to check their increase by the introduction of contagious or infectious diseases among them, as my friend Chancellor Snow, of Kansas, has been able to do among the chinch bugs of that State, seems quite remote. Since they move in such vast bodies and have such cannibalistic tendencies, being disposed to feast upon one another when other food is short, it would not be difficult to inoculate them if the proper virus could be found for the purpose.

The best preventive measure that I have seen applied is to fence them out. This is easily done.

A board 6 inches or more in width placed on edge and provided with a strip of tin bent to an angle, and projecting outward from the top of the board, will effectually exclude the insects from the field if they are not allowed to find holes under, or defects in the construction, by which they can find passages through the fence. They will not jump over 6 inches. They may crawl up the side of the board until they come to the overhanging tin caps, when they fall to the ground, but can not cross. Often they will accumulate in such heaps as to form bridges higher than the fence and the advancing forces will cross over on the

bodies of their fellows. This must be carefully watched and guarded against, as well as the accumulation of weeds, sticks, or other trash along the outside of the field. If the ground next to the fence and for 8 or 10 feet outside is made smooth and level, and a harrow, plank drag, field roller, or any other apparatus that will kill the crickets, be drawn at intervals of from one to three or four times a day over the wriggling mass along the border, thousands would be killed and injured, which the others will proceed to devour in short order.

This has been tried with very satisfactory results by the Orchard Farms Company at Bisuka and by farmers near Bellvue and at other places.

Some success has been had in herding and driving them off, causing them to pass to one side of a farm coming in the line of their march, but the plan is not so successful, as it takes a large force and occupies several days and is only applicable early in the season while the crickets are young and active, since, when they acquire their full growth and begin egg laying they are more sluggish and travel much slower.

THE PRESENT STATUS OF THE RECENT AUSTRALIAN IMPORTATIONS.

(Reports of investigations made under instructions from the Entomologist.)

A.—REPORT BY D. W. COQUILLETT.

On the 1st of August I examined the lemon and orange trees in the grove of Col. J. R. Dobbins, where about one dozen specimens of *Orcus chalybeus* were placed in July, 1892, but found no trace of this insect in any of its stages. I learned from Col. Dobbins that a short time after placing the insects on one of the trees they disappeared, and he had not seen a trace of them since that time.

I next visited the orange and lemon grove of Mr. A. Scott Chapman, at which place about 150 specimens of *Orcus chalybeus* were liberated in the month of July, 1892, but a careful examination of a large number of the trees failed to reveal a single specimen of this insect in any of its stages. Mr. Chapman informed me that his experience with these insects was the same as that of Col. Dobbins; the insects disappearing shortly after being liberated and no trace of them having been found since that time.

The following day I examined the orchards in Orange County, where some of the imported insects had been liberated. Mr. H. K. Snow, of Tustin, had received and liberated on one of his orange trees about forty specimens of *Orcus chalybeus* and two of *Leis conformis*; this was in February, 1892, but I was unable to find a trace of them after a long search. Mr. S. W. Preble had received and liberated several specimens of *Orcus chalybeus* in February, 1892, but not a trace of them could be

found at the time of my visit. Both of these gentlemen informed me that the insects disappeared shortly after they were placed upon the trees, and not a trace of them had since been seen.

I next visited the orchard grove of Mr. Hiram Hamilton, near Orange. Two colonies of *Orcus chalybeus* had been received by Mr. Hamilton; the first colony was received in February, 1892, and consisted of about half a dozen specimens; the second reached him in July of the same year and comprised about seventy specimens. A careful examination which I made of the tree upon which these insects had been placed, as well as a large number of the adjoining trees, failed to disclose a single specimen of this lady-bird in any of its stages. Mr. Hamilton's experience with these lady-birds was similar to that of the persons mentioned above. Last season it was reported that these lady-birds were breeding, and that their eggs had been found on the tree upon which this colony had been placed a few days previously, but an examination that I made of these supposed eggs of *Orcus chalybeus* proved that they were in reality those of one of our native lady-birds—either *Hippodamia convergens* or *H. ambigua*.

It will thus be seen that of the five colonies of *Orcus chalybeus* above mentioned, sent out by the secretary of the California State Board of Horticulture, not a trace can be found at the present time. Of course some of them may appear again at some future time. The fact that two of these colonies contained seventy and one hundred and fifty specimens, respectively, indicates how very difficult it is to establish a colony of these beneficial insects.

The colony of *Orcus chalybeus*, which I placed on a lemon tree in the grove then owned by Mr. A. F. Kercheval, but which is now the property of Mr. L. M. Kercheval, successfully passed the winter out of doors, unprotected by any other shelter than that afforded by the trees themselves. This colony originally consisted of about 360 specimens, 325 of which were received in January, 8 in February, and 27 in April, 1892. At the present time I would estimate their number at between 1,200 and 1,500 specimens, principally adults, but quite a large number of eggs, there being very few larvæ or pupæ. By far the greater number of specimens occur on the lemon tree, upon which I placed the original colony; on each of the adjacent trees not more than half a dozen of these lady-birds are to be found. To the northward of the original tree they have spread to a distance of about 200 feet; to the eastward, 70 feet; to the southward, 300 feet; and to the westward, 100 feet. Careful and repeated examinations of the trees outside of this limit failed to reveal the presence of this lady-bird upon any of them. I estimate that there are at the present time only about one-third as many red scales (*Aspidiotus aurantii*) upon the original lemon tree as were on it at the time that I placed the first colony of these lady-birds upon it, about nineteen months ago. The tree is about 25 feet high, with a spread of branches of about 20 feet.

A short time ago one of the papers published in Los Angeles contained a very sensational article, stating that this colony of ladybirds had increased at an astonishing rate and had spread all over the orchard. This statement, which came very wide of the mark, naturally caused a commotion among the fruit-growers, and for fear that during my absence they might carry off colonies to place in their own orchards and thus deplete the original colony, I agreed with the Los Angeles County horticultural commissioner, Mr. John Scott, that it would be advisable for the board of supervisors of the said county to employ a man to guard the colony until I could get permission to engage such a person under pay from the United States Division of Entomology. This the supervisors consented to do, and employed for this purpose Mr. John Aerni, who had rented the Kercheval place and who could thus be upon it almost constantly. Upon receiving your letter of 10th instant, authorizing me to employ a person to guard this colony of ladybirds, I at once relieved the supervisors of their charge and employed Mr. Aerni for this purpose.

The colony of *Orcus chalybeus*, which I established in the orange grove of Mr. William Niles in the city of Los Angeles, has not done as well as the one just referred to. This colony originally consisted of about 540 specimens, and was placed upon the orange tree in May, 1892. At the present time it is doubtful if a hundred specimens of these ladybirds in their different stages could be found in this orchard. The conditions appear to be identical with those existing in the Kercheval grove, and it is singular that the present colony has not thrived so well as the one referred to above.

Of the other beneficial insects imported from Australia and liberated in this vicinity I have as yet been unable to find a specimen.* Still, it is quite evident that they are established here, but in such small numbers that it might require many hours searching before even a single specimen could be discovered. This is the case with the Dipterous parasite of the Icerya, which was imported under your directions in the winter of 1888–'89. It is very rarely that a specimen of this parasite can be found. Last spring a small colony of them was found in the eastern part of this city, and a few weeks ago I found a single specimen in a widely separated locality. So we may reasonably expect that in the course of time these recently imported beneficial insects will also put in their appearance.

B.—REPORT BY ALBERT KOEBELE.

I left San Francisco by steamer for Santa Barbara on August 14 and arrived at the latter place on the evening of the following day. Mr. Alexander Craw, of the State board of horticulture, arrived the same evening, with the intention of inspecting the bugs at Mr. Cooper's

* It is necessary in this connection, in order to account for apparent discrepancies, to state that Mr. Coquillett was unable to obtain admission to the Santa Barbara orchard of Mr. E. Cooper.—Eds.

ranch, and together we proceeded to that place the following day, arriving in time to spend about two hours in examining the orchards where a number of Australian insects had been liberated last year. I had visited the place during September of last year and all the four species above-mentioned were found breeding upon *Lecanium oleæ* upon olive trees. At this visit but three of the species were met with, *Orcus chalybeus*, which was abundant last year, was, strange to say, not observed at all.

Orcus australasiæ Boisd.

This was present in large numbers at Mr. Cooper's ranch, and was feeding upon the Olive Scale. The species is well established at this place, having spread over a large field, and might be introduced upon the Red Scale with good results. The colonies we have had at Alameda and Hayward's last year appear to have perished. Large numbers of their larvæ were present at the beginning of this year at both places. In my yard at Alameda they fed upon the Pernicious Scale (*Aspidiotus perniciosus*), and larvæ of the second brood were noticed up to the end of February, 1893, after which all traces of the insect were lost. At Hayward's larvæ were noticed in numbers during November, 1892, from beetles liberated in August. Here also I am unable to find any traces of them at present. I have, through private correspondence, received this insect again this spring from Australia, and from these I have larvæ of all sizes at present feeding upon *A. perniciosus* and *A camelliæ* (= *A. rapax*) and a number have assumed the pupa state.

Orcus chalybeus Boisd.

The colony at Los Angeles upon the Red Scale is doing well, but I expected to see them in larger numbers from the conditions observed during September of last year. At Mr. Cooper's place, where the same insect was breeding so nicely during September, 1892, upon the Olive Scale, not a trace could be discovered during the two hours at my disposal. I never expected to see this beetle breed upon Lecanium in this country, as in no instance were they observed doing so in their native home. It would be still more curious, however, if this insect, after breeding so successfully during one season upon *Lecanium oleæ*, and having increased to such large numbers as it had, should entirely disappear. The probabilities are that the insect is still present in the orchard, and that before long they will be noticed again at their beneficial work. In Australia the insect is doing remarkably good work in freeing the trees of Red Scale, while on myrtle it is also rarely found feeding upon *Chionaspis eugeniæ* Mask.

Rhizobius ventralis Er.

On my visit to Santa Barbara during September of last year, I found this insect on the increase, and expected that they would soon become numerous. I have been more than pleased, on this last visit, to find

that the beetles can now be found by the millions. The first orchard visited was the one in which the first beetles received by Mr. Cooper were liberated upon 49 trees reserved in the center of the orchard. At that time those trees were all black and covered with Lecanium, but now they are free of scales. The rest of the orchard had been sprayed last year with kerosene emulsion, but the trees have again become full of Coccids. The beetles are present in such numbers, however, that it will be but a few weeks until the whole orchard will be clean. The upper orchard, where beetles were liberated at the end of May of last year, is practically free of scales, and from here the Rhizobius have spread to the central orchard and can be found by the hundreds upon every tree. The beetles were seen in copulation everywhere, and on nearly every branch the females were seen thrusting their eggs under the old scales. It will be but a very short time until every tree is clean of scales, and no time should be lost in collecting and distributing this valuable insect to all parts of the State. Mr. Cooper informs me that he has already sent out several colonies and I took occasion to visit a prune orchard near San José infested with *L. oleæ*, where a colony of these beetles was placed on July 31. The mature beetles were still present, and their larvæ, up to about half grown, quite numerous. This, in fact, is the second colony set out, the first being liberated on June 29, and beetles could still be seen when the second lot received from Mr. Cooper were liberated. I have not seen the first colony, but have not the slightest doubt that this also is on the increase. This beetle is one of the most common Coccinellids in Australia, preying chiefly upon Eriococcus, Rhizococcus, and various Lecaniinæ, and upon these last it could always be found in New South Wales on my last trip. On my first trip I forwarded this insect to Los Angeles from South Australia and Victoria, where it was erroneously supposed to feed upon Icerya. Within two years at the longest I believe that the various Lecanii in California (and Florida as well) will have succumbed to the ferocity of this little beetle.

Rhizobius debilis Blackb.

A year ago this beetle could be found nearly as numerously as the foregoing at Mr. Cooper's ranch, but at the present time they are by no means so abundant. *R. ventralis* has increased so rapidly that this species, in effect, is lost among the vastly greater numbers of the other species, and there seems little likelihood of this species maintaining itself at this place. It is this species that keeps the olive trees practically free from black scales (*Lecanium cassiniæ*) around Adelaide, South Australia, and I have always found the two species working in harmony upon Lecanium in New South Wales. The enormous increase of the one species and the decrease of the other here is no proof that the latter insect is of less value, and if *R. debilis* had outnumbered *R. ventralis* at the beginning we should probably now see things reversed.

It would be a good idea to gather the first-named species and colonize it somewhere by itself. With me the species has bred all along upon the Pernicious Scale, larvæ being observed all winter and up to April, when I left for Oregon. At present the larvæ are still found upon the same trees, but how many of the beetles are left I can not well say. The insect should be introduced upon *Aspidiotus aurantii*, upon which, without doubt, they will feed to some extent, at least as well as they do upon *A. nerii* in Australia.

Rhizobius satellus Blackb.

I was greatly disappointed in not meeting with this insect upon the Red Scale in any of the places where colonies had been liberated. The beetles were sent to Los Angeles by the thousands, as well as also to Mr. Lelong, and they may yet appear at some of the numerous localities where they were liberated. This is the most abundant Coccinellid preying upon the Red Scale in Australia, and since it is a continuous breeder, it should not take long to become numerous with us. I have attempted ever since my return to obtain specimens from Australia to introduce upon this scale, but so far have not succeeded.

Thalpochares cocciphaga Meyrick.

I have not learned whether this insect has been established upon Lecanium with us. The Hon. Ellwood Cooper liberated a very large number, and they should have established themselves at his place, if anywhere, yet Mr. Cooper has never seen any trace of them. At present there is very slight chance of this moth breeding at this place, since the scales are disappearing rapidly before the vast army of Rhizobius. At Haywards, Alameda County, where also a large number of the moths were liberated, both by the State board and by myself, and where the conditions are very favorable, I am also unable to find any trace of them, although they may be present.

ON THE INJURIOUS AND OTHER LOCUSTS OF NEW MEXICO AND ARIZONA.

By C. H. Tyler Townsend, *Kingston, Jamaica.*

A lot of locusts (Acridiidæ) has recently been determined for me by Prof. Lawrence Bruner, which enables me to present the following notes on thirty-five species. These were collected by the writer in New Mexico and Arizona, mostly during the summer of 1892, except five species from the collection of Hon. W. G. Rich, ex-secretary of this Territory. A few mesa forms occur among the following species, but most of the number are more or less injurious to cultivated crops, especially cereals and forage plants; or to native grasses, which latter

are of much importance to the Territory, since they form the main support of the cattle on our ranges. The grasses of the mountain valleys and plains of New Mexico consist principally of the common Gramma Grass (*Bouteloua oligostachya*), together with *Stipa comata* and *Aristida purpurea*.

Acridium emarginatum Uhl.—Las Cruces, August 19. ♀. Another ♀ specimen which I take to be this species, but which has the tegmina much less yellowish on sides, was taken in the Grand Canon, July 10.

Acridium shoshone Thos.—Chaves, N. Mex., August 6. ♀. Las Cruces, October 24, ♂ in alfalfa field. A ♀ taken in the Crand Canon, July 10, is slightly yellower. This species often defoliates the Mesquite near Las Cruces (see *Canad. Entom.*, 1892, p. 198).

Arphia tenebrosa Scudd.—This is a very black species with wings on oblique basal, half bright red. Sept., Las Cruces.

Arphia teporata Scudd.—Las Cruces, May 9. In alfalfa fields. Not particularly numerous.

Aulocara elliottii Thos.—Very abundant in Johnson's Basin, western Socorro County, June 22, on the short native grass which grows in the valley. It occurred in large numbers and caused considerable injury to the grass. This was in 1892. *Melanoplus occidentalis* occurred with it, and a specimen of *Camnula pellucida* was also taken. On June 23 (next day) it was found abundant farther west in valleys on the Springerville road, in New Mexico, near the Arizona line. At Pratt's ranch, just across the line in Arizona, we were told that these locusts had destroyed the garden and field crops there the previous year (1891), and had eaten up the grain fields for three consecutive years (1889 to 1891, inclusive). The ranchmen had concluded to try it another year, for the fields were in grain at that time. The abundance of the locusts at that date, June 22–23, indicated that the crops would probably be destroyed for the fourth consecutive year. On July 31, 1892, I was told at Ramah, a small Mormon settlement east of Zuni, in New Mexico, that for the four years previous the locusts had eaten up the wheat crop in that vicinity. The alfalfa crop had also been repeatedly destroyed. The description given me indicated the above species, and probably *Melanoplus occidentalis*. *Camnula pellucida* was very probably associated with them.

Aulocara scudderi Bruner.—Chaves, New Mexico, August 6. ♀.

Boötettix argentatus Bruner.—This beautiful species I have found only on Larrea. Young, May 13; adults, July 17. Las Cruces (see Can. Ent. 1892, p. 198.)

Camnula pellucida Scudd.—In swarms in the fields and along roadsides at the AI ranch of the Arizona Cattle Company, 9 miles from Flagstaff, Ariz., near the San Francisco mountain, July 16, 1892. Both sexes. A ♂ specimen is paler and quite greenish instead of brownish. A small ♂, much paler than the other specimens, was taken in Johnson's Basin, N. Mex., June 22, along with *Aulocara elliottii* and *Melanoplus occidentalis* mentioned above. Also a ♂ from the Continental Divide, in Valencia County, N. Mex., August 2.

Circotettix shastanus Bruner (?).—Flagstaff, Ariz. Common near town, and especially so just at the north of it. July 3 to 16. This is a blackish locust, which stridulates more shrilly in the hot sun than any species I have ever had the pleasure of listening to.

Conozoa texana Bruner.—Las Cruces, May 19 and September 2. Both sexes. Rather common.

Dactylotum longipennis Bruner MSS.—Grand Canon, 3,000 to 5,000 feet below rim at Hance's, July 9–10. This is a beautiful species, marked with bright red on the head, from which a median red vitta extends down the pronotum, with red on pleura and on abdomen near extremity. Wings light green, rest more or less yellowish. Hind tibiæ bluish.

Dactylotum variegatum Scudd.—A number of specimens collected by W. J. Howard

in Grant County, N. Mex., in 1882. Collection of Hon. W. G. Rich. This is a variegated, orange red, yellow and green painted species with short wings.

Dissosteira carolina Linn.—Collected by W. J. Howard in Grant County, N. Mex., in 1882. Coll. Rich.

Encoptolophus costalis Scudd. (?)—Las Cruces, May 8 to 12. In alfalfa fields. Both sexes. Very plentiful, especially along dry acequias through alfalfa.

Haldemannia tschivarensis Hald.—A ♀ pupa, lubber-like, with greatly developed thorax, was taken on mesa in spring. Las Cruces.

Hesperotettix montanus Riley MSS.—Chaves, N. Mex., August 6. ♂ This species may be recognized by its slender shape, greenish color, reddish hind femora, and bluish hind tibiæ; pronotum with two narrow black median vittæ, and one shorter lateral vitta.

Leprus wheeleri Thos.—A pale brownish species with bluish hind wings and tergum. Collected by W. J Howard in Grant County, N. Mex., in 1882. Coll. Rich.

Melanoplus bowditchi Scudd.—Chaves, N. Mex., August 6. Both sexes. A ♂ which I take to be the same species was collected at Sabinal, N. Mex., August 7. A ♀, Belen, N. Mex., August 7. Common. Some specimens vary in being quite yellowish, especially on the head.

Melanoplus femur-rubrum De G.—Chaves, N. Mex., August 6. Uncommon.

Melanoplus herbaceus Bruner—A single ♂. Las Cruces. Wholly very pale greenish in color.

Melanoplus occidentalis Thos.—Two ♂'s, Johnson's Basin, N. Mex., June 22.

Mermiria bivittata Serv.—Sabinal, N. Mex., August 7. Several females and many males. Only on *Aster spinosus*. The ♀ is very much larger than the ♂, two or three times as large. A ♀ was taken in Las Cruces, August 19. This is a very elegant slender species, especially so in the ♂.

Ochrilidia occipitalis Thos.—A ♂, Johnson's Basin, N. Mex., June 22. A ♀, Holbrook, Ariz., June 27. The ♀ is more reddish than the male specimen.

Paratettix mexicanus Sauss.—Grand Canyon, 3,000 to 5,000 feet below rim at Hance's, July 10.

Paratettix toltecus Sauss.—Grand Canyon, July 11. ♂ ♀. Four thousand to 5,000 feet below rim at Hance's. The ♀ differs from the ♂ by having four black spots on the prolongation of pronotum, the two anterior ones largest, opposite, one on outer edge at each side; the two posterior ones small, and on crest in median line.

Psoloessa (?) *maculipennis* Scudd.—A single ♂, Johnson's Basin, N. Mex., June 22. Grayish brown, tegmina marked with black on sides, hind tibiæ red.

Spharagemon balteatum Scudd. (?)—Chaves, N. Mex., August 6. A single ♀.

Syrbula montezuma Sauss. (?).—Grand Canyon. ♂ ♀. Four thousand to 5,000 feet below rim at Hance's. July 9–10. This is a slender species, much resembling *Mermiria bivittata*, but smaller.

Tæniopoda picticornis Wlk.—A large lubber-like black species, with orange-colored pronotal crest or ridge. Collected by W. J. Howard in Grant County, N. Mex., in 1882. Coll. Rich.

Thrincus aridus Bruner.—Las Cruces, ♂ ♀. One specimen taken May 18 has a very bleached appearance, and is determined doubtfully as this species.

Trimerotropis cœruleipes Scudd.—Turkey Tanks, Ariz., July 17. ♂ ♀.

Trimerotropis vinculata Scudd.—Las Cruces. This species was found in numbers in north end of Organ Mountains, November 26, 1892. A pair was taken there *in coitu* on that date.

Tropidolophus formosus Say.—This is a green species, mottled with brownish, with a remarkably crested pronotum and abbreviated wings in the ♀. The ♂ has orange-red wings. Collected by W. J. Howard in Grant County, N. Mex., in 1882. Coll. Rich.

Xanthippus zapotecus Sauss.—A ♀, Johnson's Basin, N. Mex., June 23. A much larger ♀, nearly one-fourth longer, captured on the Jornada del Muerte, to the north

of Las Cruces. This is the shortest flying Acridiid, I believe, that we have in this region.

The above thirty-five species represent twenty-five genera.

EXTRACTS FROM CORRESPONDENCE.

The Corn-Root Plant-Louse.

I inclose for your inspection a stalk of maize. It has now upon its roots quite a number of small greenish insects from the size of a pin-head to smaller; also several small common black ants. You will observe the plant is in a languishing condition, in fact it is not so large as it was a week ago. There is quite a large acreage of corn in this county (Montgomery) so affected. My crop, or a portion of it, was damaged fully 50 per cent last year by the same insect.—[E. P. Thomas, Md., June 27, 1893.

REPLY.—The insect which is found upon the roots of your corn is the common Corn-root Plant-louse (*Aphis maidi-radicis*) and the ant is the common and wide-spread species known as *Lasius aliena*. The plant-louse is almost entirely dependent for its existence upon the care taken of it by the ants. It seems, in fact, to pass the winter only in the nests of this particular ant. It feeds early in the spring upon the roots of the smartweed (*Polygonum persicaria*) and may also live for a short time upon the roots of pigeon grass (Setaria). Its main food plant, however, is corn. The winged generation appears early in the spring and by this means the species is dispersed. Were it not for this fact, rotation of crops would be an almost perfect remedy. It is, in fact, a remedy of secondary importance, even with the dispersal of the species by the winged brood, and continuous cropping of the same fields with corn affords the best conditions for the increase of the root-louse. There are no actual remedies which are applicable at the present time, but a great deal may be done towards lessening the numbers of the insects the coming season. Late fall plowing and harrowing by removing the old cornstalks and breaking up the nests of the ants after these have become dormant for the winter, a thorough stirring of the soil with disk harrows in the early spring to keep down the sprouting herbage, or any treatment of the field in the fall which will keep down the smartweed and pigeon grass will bring about a beneficial result.—[June 29, 1893.]

Destructive Locusts in Colorado.

* * * As near as I can determine the grasshoppers that have been working here are the natives. They have hatched out from quite early until within a few days. There have been all sizes of them from the most minute to the full grown. So far they have done but little toward depositing their eggs. Our experience here may do some good to others. First we used a sled 14 to 16 feet long, with boxes like your Pl. 8, Fig. 1. This was filled with limewater. A great many were killed this way. Then they took about the same machine, only made out of iron or tin, and used water with coal oil. Then the same thing was used with coal tar and oil. This was the most effectual, though more costly. Some farmers caught as high as 200 bushels of them. Last, but by no means least, is the bran and Paris green mixture, which they like better than any growing crop, and which slays them by the thousands. The mixture they are using here is 100 parts of bran, 3 parts of Paris green, and some old molasses or other cheap sweet substance to make it stick together. Probably two quarts to the 100 parts bran will be enough. This is strewn along between the rows of potatoes or corn or through the alfalfa fields. The hoppers will leave all other food for it. If there is water they can get to drink near by they die very fast; otherwise, it is several hours before they will give up. It is estimated that

20 per cent of the crops have been damaged by them. In some localities 50 to 75 per cent have been entirely destroyed. We think that for this year their damage is mostly done. The thing now is to head them off for another year. Farmers are still setting out poison and are bound to kill off as many as possible, so as to lessen the number of eggs laid. Plowing and late irrigation will be done.—[H. B. Jackson, Colo., August 15, 1892.

Locusts in Colorado—Another case.

Recently, while in Colorado, I incidentally visited Grand Junction, at the request of the board of trade of that town, to look into a grasshopper or locust plague that has been present in that valley for the past three years. I herewith send you a brief report of conditions as they were found:

About four years ago it was noticed that grasshoppers were unusually abundant on a piece of waste land near the river south of the town of Fruita, which is situated on Salt Lake Western Railroad, about 12 miles west of Grand Junction. The next year these hoppers spread to several of the surrounding farms, where they did some damage to crops and orchards. The next year these hoppers had increased to such an extent that they did considerable injury to both crops and orchards. In fact, they did many thousands of dollars' worth of injury to the peach orchards, which thrive here as nowhere else. One orchard alone is reported to have suffered to the extent of $25,000. This orchard was visited by me, and as it is 80 acres in extent and was fully half destroyed I do not doubt that the injury was fully this great. A great many other orchards, both large and small, were more or less completely destroyed by these insects last year. With all this amount of injury going on about them the inhabitants did but little fighting, and what fighting they did do was undertaken so late in the year that it did comparatively little good. The warfare did not begin until after the hoppers had attained their growth and were winged. At this time they had left the grain fields and were most, if not all of them, in the trees composing the various orchards of the region. Here they remained upon the twigs and branches feeding upon the leaves and tender bark of the new growth. When here it was next to impossible to dislodge the pest and get at it. Some bran and arsenic was used, but so carelessly in many instances that not only were domestic fowls and an occasional larger animal, but also nearly all of the native birds of the region, destroyed. Only one good feature of the use of this remedy was the destruction of many rabbits.

This year I chanced to visit the region about a week before the mass of hoppers concerned in this destruction had attained their growth, and was, therefore, in time to do some good for the inhabitants by suggesting a more profitable and at the same time practical method of warfare, viz, the use of the hopper dozer or kerosene pan. In driving over the region for several days prior to my suggesting a definite remedy it was ascertained that the majority of the locusts were confined to the edges of alfalfa and grain fields, or else they were to be found in the rank vegetation along the edges of irrigating ditches. In these localities it was observed that the most practical remedy that could possibly be brought against them was the "dozers." Accordingly several of these machines were ordered made and several meetings of the farmers of the region were planned. At these meetings addresses were delivered outlining the various methods that have been and that might be used in fighting locust pests. Both the practical (such remedies as can be applied with a saving) and the impractical (such as cost more to apply than would be the value of the crop intended to be saved) remedies were described at some length. In the case under consideration, where the people were not overburdened with cash, I insisted upon the *practical* remedies, although there were many among the audiences who insisted upon some remedy where there was to be little or no outlay of labor.

Prior to my arrival in the valley the citizens of Grand Junction sent to the Colorado oil region at Florence and secured a 1,000-gallon tank of crude petroleum oil for use in destroying the 'hoppers. This, I ascertained, it was intended to use by pouring it into the irrigating ditches, and in that manner spread it over the country. In my address I insisted that this would only be wasting the material and destroying the vegetation wherever the oil reached, and that the 'hoppers would be mostly all left unhurt. We tried the oil in the "hopper dozers" and were surprised at the results. It worked much better than the refined oil does, and its cost was so very much less, being only 4 cents per gallon delivered at Grand Junction.

There are several species of locust concerned in these injuries in and about Grand Junction. I found *Melanoplus atlanis*, *M. bivittatus*, and *M. differentialis*. There were also several other species of locusts that were very numerous in the valley. One of these was what appears to be an undescribed species of *Pezotettix*, bearing some resemblance to *M. turnbulli*, only with very short and narrow tegmina. Like that insect, this *Pezotettix* also seems to confine its attention almost entirely to the various species of Chenopodiaceæ, of which there are quite a number of forms common to the region. It is especially fond of the grease-wood (*Sarcobates vermicularis*). Peculiarly enough was the fact that on my arrival in the valley all the plans that were then under way were for the destruction of this "native" species of *Pezotettix* that did none or very little of the injury that had thus far occurred in the region.

If the instructions which I gave and insisted upon being carried out be followed by this time the valley could be practically free from this pest. I would also state that aside from the price paid for labor the cost for this extermination would not be above a couple of thousand dollars; while, if nothing be done, there are or were hoppers enough in the valley to destroy a half million dollars' worth of crops and trees. Last year the pest might have been handled for even less than this amount, and the $200,000 and more of injury that was sustained might have been saved. I even went so far in my remarks as to state that if one-tenth of the amount lost on the one orchard referred to above had been properly expended at the right time last year there would have been no need of worry and fighting the present year, and nearly all the loss sustained might have been avoided.—[L. Bruner, Nebraska, July 10, 1893.

A Peculiar Gad-fly.

I inclose sample of a species of Tabanus that is very annoying to stock after sundown. They do not appear during the day, except rarely on very dark days, but in June and the early part of July they swarm upon cattle and horses after sunset and render them well-nigh frantic in their efforts to escape. As soon as darkness comes on, or say about half-past eight now, all the flies disappear. One hour each evening is about the extent of their feeding time, and as they all come at once they make lively times in the cowyard. Milk cows, etc., can be protected by stabling in dark place every evening, but this is impracticable with herds in pasture.—[G. M. Dodge, Missouri, June 18, 1893.

REPLY.—* * * Your account of the habits of the species which you send—*Tabanus tectus*—is very interesting. Can you not ascertain the breeding habits? You have a good chance to try the effect of fish oil and other repellants which act fairly well against the Horn Fly. I should be interested to know whether they will keep off the gadflies.—[June 21, 1893.

SECOND LETTER.—*Tabanus tectus* is now nearly gone. I got one specimen to-night at about 8 p. m., considerably worn. Saw no others. It usually lasts about one month, and is single brooded. I did not learn its breeding habits.

As advised in your letter I tried fish oil as a preventive. Mixed it with bacon fat and put it on in the evening, when the flies were most plenty, which was about 8 o'clock. It seemed to have no effect. The flies would alight and draw blood where the hair was shining with grease. There were but one or two cows in the herd that

it could be tried on satisfactorily because the most of them would do their best to fight the flies off. Only once did I see a fly foiled by the grease. It alighted on a very greasy place and moved twice, trying to insert its proboscis, and then let go and fell toward the ground. It was so dark that I could not tell whether it was smothered by the oil or whether it flew away.

The oil that I used may not be the best. I had been using it for horn flies, and it only affords protection about one day. I tried it for gadflies on three evenings.

There are a great many species of gadflies here; more than I ever saw elsewhere. But none are abundant except *tectus*, and no others are nocturnal in their habits, or perhaps I should say crepuscular, as *tectus* remains only while twilight lasts.—[G. M. Dodge, Missouri, July 26, 1893.

REPLY.—* * * I am surprised about the nonsuccess of the fish oil, the more so as you state that it will only keep the flies off for one day. A recently published bulletin of the Louisiana Experiment Station states that the fish-oil emulsion will protect stock for four or five days. It may be that your oil was not good, or perhaps that emulsifying it increases its effect. I should think that it would make it more lasting.—[July 31, 1893.

Termites Swarming in Houses.

* * * An insect resembling an ant appears to have taken up its permanent home with me. They come out only in the spring, remain for a period of two or three weeks and then disappear to be seen no more until the following year. So for ten years, their habitation appears to be near the kitchen range around which they first appear; as time passes they leave that locality and strive to leave by the west window—some ten feet away. They are in such considerable quantities as to become a pest at times. A cupful at a time nearly, has been found.—[Edwin M. Truall, Washington, D. C., June 3, 1893.

REPLY.—The insects which are swarming in your house, although so closely resembling true ants, are representatives of a different order and are closely related to the remarkable white ants or "termites" of Africa. The insect is known scientifically as *Termes flavipes* and the early stages are passed in dead and usually more or less decayed wood. It is found in stumps and old logs and inhabits the timbers of many houses and other buildings in this city which have been erected for some years. The larvæ burrow in the timbers but fortunately take a longitudinal direction and never sever the main fibres, so that the timber may be pretty well riddled by them and still retain a great proportion of its sustaining strength. In the course of years, however, it must become considerably weakened. The probabilities are that some of the joists in the walls or under the floors of your kitchen are infested by these insects which become full grown in the spring and attain wings. The winged individuals may be destroyed by insect powder, but the annual flight will continue until the colony is destroyed. This can only be done by either renewing the timbers or by injecting a quantity of kerosene into the burrows, which, of course, must first be discovered and uncovered.—[June 3, 1893.]

Carbolic Acid for Rose Chafers.

I have been spending considerable time and material on the rose bug or Rose Chafer, as it has been our worst enemy on our grape tracts, endeavoring to find some remedy and have succeeded at last. Nothing among our poisons will kill them except one article, and that is crude carbolic acid; they can not live ten seconds put into it, and 1 gallon of acid to 100 gallons of water will clean them from fruit trees or grape vines and not injure fruit or foliage. I found this out by experimenting when they were abundant this year, and procured a horse-power spraying machine and went over 23 acres that were covered with them and cleaned them out. This was about the 18th of June when the grapes were in blossom, and only one applica-

tion was made. My cherries were saved in the same way. This is a cheap remedy and a sure shot for them.—[S. Justus, Ohio, July 10, 1893.

REPLY—The Entomologist reports that while he is hardly willing to admit that the result of your single experiment proves the efficacy of carbolic acid, he is, nevertheless, greatly pleased at its success and when opportunity offers he will conduct further experiments in the same line.—[July 13, 1893.]

Abundance of Tent Caterpillars.

The Apple-tree Tent-caterpillar (*Clisiocampa americana* Harr.) seems to have its own way in the town of Andover and portions of Lawrence. Nearly every tree is covered with them. The farmers do not molest them and I have been informed that they have not done so for a number of years past, and of course the caterpillars are getting worse every year. I collected some of the larvæ and I find that some of them are parasitized by the Tachina flies and some with Ichneumons.—[Geo. B. King, Mass., July 3, 1893.

An Alfalfa Worm in Wyoming.

During the last week of May an "army" of worms appeared upon the young alfalfa on the McConnell ranch, near Jetsam. In a few days the greater part of 80 acres of alfalfa looked as if scorched by fire. As soon as the damage was noticed the work of irrigation was hurried and the ground flooded as fast as possible. Wherever it was possible to cover the ground with water the worms were destroyed. Uneven ground where water could not be run had to be left to the birds. Black birds, larks, and American robins were especially active. Three weeks would cover the entire time of the irrigation. The worms after abandoning the alfalfa continued their work upon wild sunflower and a few other plants along the banks of the ditches and laterals, working in the same manner as upon the alfalfa by webbing up the plant, and then eating the leaves. It is not usual for these worms to attack alfalfa. It may perhaps be explained by the fact that other vegetation is rather scarce owing to extremely dry weather.—[E. G. Lamberson, Wyoming, June 29, 1893.

NOTE.—The alfalfa worm is the larvæ of a species of Loxostege nearly allied to *L. sticticalis* which damaged sugar beets in Nebraska during 1892.

Tansy and the Plum Curculio

I am reminded by the inquiry of G. L. F. in *Scientific American* of to-day's date—page 45, paragraph 5186—of the perfect protection from insect attacks afforded a wild plum tree transplanted from the woods into my father's garden more than fifty years ago, by a clump of tansy growing all about the tree trunk. Plums ripening about a bed of tansy will not be found stung, but coated with a sort of "frosting" quite bitter to the taste, a bloom such as covers the skin of the grape. [G. W. Devin, Iowa, July 15, 1893.

REPLY.—I have heard of this protection of plum trees by tansy and have referred to it in some of my writings on the Plum Curculio, but heretofore have always been more or less skeptical in regard to the matter.—[July 18, 1893.]

A Handsome Blister Beetle.

I inclose under another cover a couple of insects taken upon the top of Short Off Mountain, at an elevation of about 5,000 feet above sea level. They are found feeding upon *Robinia viscosa*; were quite plentiful. The gentleman who was with me says that a few days before he saw immense quantities of them upon Whitesides at about the same elevation where they had nearly, if not quite, denuded the *Robinia viscosa* of its foliage. Have not observed them yet at a lower elevation. What are

they and what will be the best method of destroying them should they attack any ornamental or fruit trees or other crops?—[James B. Smith, N. C., July 3, 1893.

REPLY.—* * * The beetles which you send are specimens of a very handsome species of Blister Beetle, the scientific name of which is *Pomphopœa unguicularis*. This species occurs in such numbers rather rarely, and your observation is interesting. Should they attack ornamental or fruit trees, or other crops at a lower elevation, you will be able to destroy them by applying Paris green or London purple in the proportion of one-fourth pound to 40 gallons of water.—[July 15, 1893.]

Trapping the 12-spotted Melon Beetle.

Maj. M. F. Berry, of Pachuta, Miss., thinks he has discovered a successful trap for this destructive beetle. It is simply an old gourd. All the gourds of last year lying about are utilized. He cuts holes in the gourds not larger than may be stopped by a large corncob, and after removing a part of the seed and old pulp, places them about the spots most frequented by the enemy. These traps seem wonderfully attractive to the beetles. I have seen as many as 40 taken out of one small gourd, and that twice a day. To kill them, after catching, is a trouble. So far he has found hot water effective. Wetting the inside of the gourd seem to render it more attractive to the insects. For garden practice, nothing more could be desired. But for a large cornfield now, it would require a great many gourds, and be very laborious collecting them twice a day, or even once. It might be well to try a few drops carbon bisulphide. Any plan that destroys, or seriously diminishes, these Pests is worth knowing. They have caused the crop to be planted over again a second and third time in places; and this means a loss of 25 per cent, besides the labor expended.—[Lawrence C. Johnson, Mississippi, June 15, 1893.

Tasmanian Insects.

Our principal troubles here, in the order of their severity, are: The Fusicladium, Codling Moth, Army Worm, and undergound Grape Grub, Mussel Scale, and American Blight (Schizoneura). I have carefully experimented with the Fusicladium, and my best results have been attained by the use of the Bordeaux mixture and kerosene emulsion, with 1 to 20 of copper sulphate. It is worthy of note that one variety of apple escapes, the true Adam's Pearmain, a tall, flat-crowned apple. As regards the Codling Moth, there are already fruit boards in all parts of the colony, with inspectors, etc., and I can do but little else but advise, as they are unfortunately not under the control of my department, the council of agriculture. I can, at least, say that when reasonable care has been taken in picking off the infested fruit, and also in spraying once or twice with Paris green or London purple, the moth has been very considerably reduced, and in some places completely exterminated. Our chief trouble in this respect arises from the unwillingness of the owners of very small orchards; in other words, those who are not dependent upon them for their living, to carry out the provisions of the act. I am sorry to say that the Cherry Leech is spreading with great rapidity. It is only six years since it first made its appearance from New Zealand, but it is now all over southern Tasmania. I have not succeeded in finding any parasite which attacks it, so we are reduced to the usual treatment of spraying with hellebore, etc., and dusting with lime, ashes, etc. I have reared three parasitic flies from *Lachnosterna fusca*, but they are by no means plentiful. The Wheat Aphis appeared last season, but it was immediately suppressed by a small Microgaster, which has eighteen joints in the antennæ; the wings are veined and are hyaline, while the veins and stigma are light brown. The size is very minute. * * *.—[Edw. H. Thompson, Government Entomologist, Tasmania, April 15, 1893.

The Plum Curculio in Door County, Wis.

Until recently the peninsula lying between Green Bay and Lake Michigan has been free from invasion by the Plum Curculio, *Conotrachelus nenuphar*, and until the

present summer it has never been found in the part of this peninsula lying north of Sturgeon Bay, so far as can be learned from fruit-growers in that region. In consequence of this, plum-growing is becoming an industry of some importance in that district.

Wishing to learn positively the extent to which this part of Wisconsin enjoys immunity from the Plum Curculio, I visited Sturgeon Bay village about the middle of July, and made a careful observation of the Plum and Cherry orchards in the vicinity. North of the bay the most careful search failed to discover a single curculio-infested Plum, though more or less of this fruit is grown on almost every farm and on many village lots. A very few infested cherries were, however, discovered, but in every case the owner of the trees declared that "wormy" cherries had not been known there until the present season. South of the bay the case was different. The plums were more or less infested, especially those lying toward the west side of the peninsula. In several instances the infection had not yet been discovered by the owners of the trees; in others it had been discovered, but all agreed that it was new in that locality. The invasion apparently proceeded from the southwest, as orchards appeared to be affected more on the southwest side than elsewhere.

It is generally agreed by the farmers in the vicinity of Sturgeon Bay that the Pea Weevil, *Bruchus pisi*, is entirely absent from that region, though it is said that it was once present there.—[E. S. Goff, Wisconsin, Aug. 16, 1893.

The Juniper Bark-borer in Nebraska.

I send you a number of specimens of beetles found on one of my red-cedar trees, which are proving to be quite destructive. I have used several emulsions, but have not succeeded in "hitting" them. They bore into the axil of the twig until the twig falls over and dies, and then they fall off. Often they burrow on the outer angle and sometimes cut the twig off above the angle. The same tree from which these are taken was attacked in 1884 by the same beetle. If known, please send me name and remedy.—[R. Harvey, Nebraska, August 14, 1893.

REPLY.—The insect which you send, and which is affecting the red cedar in your vicinity, is known as the Juniper Bark-borer (*Phlœosinus dentatus* Say), a very small insect belonging to the family Scolytidæ. This insect is making its appearance in the West at various points, and has already occasioned considerable loss and destruction to the red cedar in different sections of Kansas and other Western States. Its normal region is included in the Middle States and Eastern States and Canada, where it affects both juniper and arbor vitæ. In Kansas its introduction was traced to certain cedar posts brought to the lumber yards from Michigan and Arkansas, and its introduction into your section was doubtless by similar means. It is found to be attacked by a parasitic fly belonging to the genus Spathius, and it was doubtless the increase of this or other parasites which led to the disappearance of this pest after its first appearance with you in numbers in 1884. It is quite likely that its abundance the present season will again result in a like increase of natural enemies, again reducing its numbers to a minimum. There is no remedy except the rather heroic one of cutting down and destroying all infested trees in the region in which it has become introduced or perhaps by weakening trees by injuring them artificially, so that the beetles will be attracted to these, preferring, as they do, diseased trees to vigorous ones. Later on the treatment is consummated by burning these trap trees.—[August 22, 1893.

Spider Mimicry.

At Jamesburg, N. J., in August, 1893, I found on a small oak tree what was apparently a gall, perfectly formed, growing on the upper surface of a leaf. On handling the leaf for closer inspection the supposed gall rolled off into my hand, leaving the surface of the leaf entirely free from any scar or other indication of the gall's pres-

ence. Turning my attention to the latter I discovered it to be in reality a spider (*Ordgarius cornigerus* Hentz) which had been resting on the leaf, its curiously formed abdomen simulating exactly both in form and color the common oak gall, even to the tiny punctures through which the gall insect makes its exit when mature, a remarkable example of protective mimicry.—[R. S. Lull, Washington, D. C., September 11, 1893.

A new Scale Insect in Florida.

I inclose a piece of wood from plum tree that is covered with a scale which is destroying a large number of peach and plum trees in this section. The tree I cut this piece from was sprayed a few days since with kerosene emulsion—2 pounds whale-oil soap, 4 gallons kerosene, 40 gallons of water. I do not think these scales are killed, even with that, and I have tried pure kerosene and failed to kill all. What is the scale? What is the best way to destroy it? It appeared in my orchard several years since and has killed, or materially damaged, a few trees every year. I find that during the spring and summer they cover the body and larger limbs with a cottony substance, making a complete covering about the head of the tree and extending up on the larger limbs and down the trunk several inches. I have seen trees 5 inches in diameter killed entirely. The bark dies at the head when covered and extends up the limbs and down the body until the whole tree is dead. I discovered a month ago that there was a minute red-bodied fly mixed with the wax or coming out of them. In connection with this cottony stuff I see a black worm covered with spines or hairs. They are about three-sixteenths of an inch long, one-third as thick, and oval in shape. They get completely covered with the cottony stuff, and moving around on the tree look like a white ball.—[S. S. Harvey, Florida September 5, 1893.

Reply.—This sending is of extreme interest, as the species is new to science and has never been written up in print. Curiously enough it appeared suddenly in Washington upon a few young peach trees a little over a year ago. We have been unable to trace the origin of the scale, as these trees were grown from seed, and although a careful search has been made for other infested trees no result has been accomplished. We shall be very glad if you can offer any hints as to its origin with you. It belongs to the genus Diaspis, to which a number of scale insects which are very destructive also belong, notably the Rose and Blackberry Scale (*Diaspis rosæ*). You are correct in supposing that this is the wrong time of the year to spray, since the eggs are at this time protected by the old scale of the female. These eggs will hatch, however, early next spring, and the young unprotected larvæ will migrate to the new growth of the trees. A spraying with kerosene emulsion at that time will destroy these young, and prevent the spread of the species and also further injury to the infested trees. The minute red-bodied flies are the males of the wingless scale-covered females. The cottony stuff is thready wax secreted by the insects. The small black worms covered with spines are the young larvæ of some lady-bird beetle which feeds upon the scale insects.—[September 11, 1893.

The Stink Bush as an Insecticide.

I will now give in detail my experience with the "Stink Bush" and the facts which led me to suspect that it contained insecticides. During the winter of 1870–'71, Mr. F. Hinson, of Harrisville, passed me with a sack full of the leaves from which he made decoction for destroying the lice on a colt. He told me afterwards that it was successful. Mr. W. I. Hilton, of Harrisville, as well as others, used the leaves for the same purpose. This summer I have tested the matter and am to-day satisfied that the leaves possess no insecticide properties. I have made four experiments. The result of the first was given July 1, and I had yours as a check, concerning which I will refer later. The second and third gave negative results. Fresh

leaves and balls were used in all three experiments. The last and fourth was with carefully dried green leaves reduced to a snuff or powder. The decoction or infusion of this last gave negative results also, but revealed a ropy consistency, something like Slippery Elm. For sometime I was greatly perplexed, after receiving your statement that your results did not agree with my first experiments, which had stimulated me so much, but I have decided that the effect on the worms, which was similar to the effect produced by treating with a decoction of tobacco, was really the poisonous effect of nicotine. I used a vessel in which I had made a previous decoction of tobacco, and merely rinsed it out, and boiling the leaves and balls in it, of course, brought out all the adhering strength and produced results as stated. Or, possibly, this gum closed up the breathing pores, which should have been the case with your experiments also, if true, but this even would not have produced the spasmodic symptoms so characteristic of tobacco poison. Be this as it may, I have no faith in it as an insecticide.—[S. B. Mullen, Mississippi, September 1, 1893.

Alleged Killing of a Dog by the "Hickory Horned Devil."

I express you this day a worm, which I would like you to examine and give me name, etc. This bug was brought to this place by a negro who lives near here, and his story is that his dog went into a patch of weeds near his house, and yelping as if in pain ran out with this bug fastened to his lip by one of its horns. The dog lived about an hour and then died, with symptoms of hydrophobia; at any rate, it had fits of that character. The weed patch, which was small, was examined for a snake, but none could be found.—[T. R. McGuire, Mississippi, September 8, 1893.

Reply.—The caterpillar which you send belongs to the striking species known in the South as the "Hickory Horned Devil." The moth into which it transforms, known scientifically as *Citheronia regalis*, is a large insect, having a wing expanse of about 5 inches and a beautiful olive and reddish coloration. This caterpillar feeds upon the leaves of the Hickory, Oak, Persimmon, and a few other trees, and the species is not a rare one. The larva, although so ferocious in appearance, is entirely harmless, and may be handled with perfect impunity. The negro's story is unworthy of credence, unless perhaps the dog was actually bitten by a poisonous snake which was not discovered.—[September 11, 1893.

NOTES FROM CORRESPONDENTS.

New Food Plant of Pseudococcus yuccæ.—The third week in June we received specimens of this interesting Coccid from Mr. D. W. Coquillett, who found it feeding upon *Ceanothus oliganthus*, at an elevation of from 2,000 to 5,000 feet. It occurred in large numbers, one medium-sized tree having been nearly killed by it. The other food plants of the species are *Yucca whipplei* and *Mimulus glutinosus*.

The Eggs of the Leopard Moth.—Mr. Herman Meeske, of Brooklyn, has been kind enough to send us a female of *Zeuzera pyrina*, taken in the act of ovipositing. He also sent us the entire batch of eggs, which we have had carefully counted, with the result that between 1,000 and 1,100 eggs were found.

Cigarette Beetle eating Silk.—A correspondent of the Division writes from Winter Park, Florida, to complain of the damage done by beetles and larvæ of *Lasioderma serricorne* which are feeding upon silk with which certain furniture is upholstered in her house. We have recommended either benzine or bisulphide of carbon treatment and place the fact on record simply on account of the habit.

A new Food Plant for Papilio turnus.—Dr. Ben. H. Brodnax, of Brodnax, La., sends us the larva of the common Tiger Swallowtail, which he found upon some camphor trees (*Camphora officinalis*) growing in his vicinity, which were sent out from this Department some years ago.

Vedalia at the Cape of Good Hope.—Hon. T. A. J. Louw, who carried over Vedalia to the Cape of Good Hope last year, writes us, under date of June 8, that although claims have been made that the native *Rodolia iceryæ* is equal to the Vedalia in keeping Icerya in check, later developments show the superior value of Vedalia. The latter insect has increased so numerously in the cages that they are being distributed to all parts of South Africa.

An Army Worm occurrence.—Dr. G. A. Hankins, of Toano, James City County, Virginia, wrote us under date of the 17th July that the Army Worm, *Leucania unipuncta,* was present in his millet by the thousands. The worm was noticed in small numbers in the same field last year. He also sent specimens of the Red-tailed Tachina fly, which is stated to have been so abundant that the buzzing sounded like a swarm of bees. We assured him that the worms will not be injurious next year. The most interesting point of this instance is that the injurious brood of these insects is certainly the second and perhaps the third generation. The usual date for the appearance of a destructive brood in southern Virginia is the latter part of May or the first week in June, and this brood consists of the immediate offspring of the hibernating individuals.

Another predaceous Lepidopteron.—Mr. J. G. O. Tepper, of the South Australian Museum, writes us, under date of May 30, that he has reared *Thalpochares dubia* from a larva found feeding upon the Black Scale in South Australia. The predatory species is not numerous enough, however, to produce any appreciable effect upon the scale insect.

Kerosene Emulsion against the Hop Louse.—Prof. F. L. Washburn, of the Oregon Experiment Station, writes us that he has tried kerosene emulsion on the hop vines much stronger than has been recommended in various bulletins with no bad effects to the vines. He therefore infers that the complaints of growers in this connection arises from their carelessness in compounding and using the emulsion. This is a significant statement, since in a recent bulletin Prof. Washburn concludes that the emulsion is unsafe for the average hop-grower to handle.

Periodicity in Insect Attacks.—A correspondent in answering our Cicada circular mentions the fact that in his opinion tent caterpillars have periods of 13 years, judging from the fact that at such intervals he has noticed that they are very abundant. This observation, however, is founded upon a coincidence and one which affects only a single locality. Fall web worms are annual or semi-annual in their development and the fact that we have seasons of immunity from their attacks is due to the unusual appearance of parasites or to unfavorable climatic conditions.

Army Worm in New Mexico.—Mr. T. D. A. Cockerell informs us, under date of August 9, that *Lecanium unipuncta* is present near Las Cruces in the larval state in millions. One field of alfalfa was defoliated and the caterpillars were destroying Corn and Capsicum and even climbing Apple trees.

A new Hopperdozer.—Rev. M. Wirtner, of Boulder, Colo., writes us that this summer a hopperdozer 15 feet long, 2 feet deep, and 4 to 5 feet wide was constructed by a prominent ranchman for the purpose of fighting the local grasshoppers which have been so destructive. The box was divided into 16 compartments and each compartment filled with milk-white lime water. Excellent success in the use of this contrivance is reported.

Fondness of small black Ants for Kerosene Oil.—Some recent correspondence with Mr. H. L. Hutson, of Texas, and Dr. W. S. Dudley, of Georgia, shows that flat boards covered with kerosene and placed near the nests of *Dorymyrmex pyramicus* in a Georgia town proved very attractive to the ants. They clustered upon it and brought grains of sand with which to cover it. Wherever such kerosened boards were placed the ants found them and covered them with fragments of sand and wood. This is a habit new to us and would seem to indicate that the ants appreciate the danger to themselves of leaving the kerosene uncovered.

GENERAL NOTES.

PARTHENOGENESIS AMONG SPIDERS.

Under the above title* Mr. Damin presented a paper before the zoologisch-botanischen Gesellschaft of Vienna at its meeting of March 1, 1893. After referring to the frequency with which parthenogenesis occurs in the various orders of insects, Mr. Damin stated that up to the present time it had not been reported as occurring among spiders. He then recorded what he believed to be a case of the parthenogenesis of Araneina. In the spring of 1891 he inclosed separately two living specimens of *Filistata testacea* Latr., for the purpose of observing them. One of these molted twice during the summer of 1891 and once the following spring, "a proof," Mr. Damin says, "that when inclosed it was unripe—that is, was, according to our present knowledge of the subject, incapable of reproduction." This female spun an egg-sac on the 8th of July, and eighteen days later Mr. Damin was surprised upon opening the egg-sac to find sixty-seven young spiders in it. Two days later they molted. At the time the paper was presented the young spiders were still alive and have safely molted once outside of their cocoon. Mr. Damin asks: "Does this not tend to prove that parthenogenesis obtains in the case of *Filistata testacea*, and perhaps also with other spiders?" And he adds: "The possibility of a mistake is here out of the question." Mr. Damin then refers to the fact that this Filistata is very common in Croatia, and is well represented in his collection, but says that he was struck by the fact that there was no male among them, and that he had never seen a male, either dead or alive. He then asks if this absence of the male does not indirectly indicate the parthenogenesis of Filistata, and adds that neither Thorell in his two works nor C. Koch mentions the male of *Filistata testacea*. The arachnologists, Dr. C. Chyzer of Ujhely, and Prof. W. Kulczynski, of Krakau, wrote that they had not found the male of Filistata. The latter had received one male specimen from Madeira. Mr. Damin remarks further that additional observations are necessary to show whether parthenogenesis is a chance occurrence with Filistata, as with *Bombyx mori* and some butterflies, or something which occurs normally, as with Psyche, Solenobia, etc. He mentions also, as worthy of note, that this female spider which had produced young parthenogenetically cast its skin two months later, although it has been considered well established heretofore that after the first deposition of eggs spiders do not molt.

The evidence thus adduced by Mr. Damin seems to us inconclusive, since spiders in confinement are well known to differ somewhat from their normal habits, and especially are known to shed one or more

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* Ueber Parthenogenesis bei Spinnen. N. Damin, Verh. d. k. k. zool.-bot. Gesell. in Wien, Jahrg. 1893, XLIII Band; II Quartal., pp. 204–6.

skins, although adult. The fact, then, that the specimens under observation by Mr. Damin shed skins does not prove that they were immature when captured. Having shown the possibility that they were mature, the further possibility that they had been impregnated by the male before capture and that the spermatophores had remained alive in the *receptaculum seminis*, as they have been known to do for months, must be admitted. The entire evidence thus breaks down and we must await further proof. It may be worthy of mention also that the male of Filistata is well known in this country.

THE BLATTARIÆ OF AUSTRALIA AND POLYNESIA.

In the Transactions of the Royal Society of South Australia for 1892, Mr. J. G. O. Tepper has published an important paper describing fully the Blattariæ (or Cockroaches) of Australia and Polynesia. He brings into his list 193 species, representing 33 genera and 10 families, of which one family, 9 genera, and 55 species are new. This is a very considerable proportion of the known species of the world. Eliminating the many synonyms which occur in Walker's catalogue of the species in the British Museum, Brunner van Wattenwyl has computed the number of endemic species to be 343 and those of wide distribution to be 35. Two only are wholly cosmopolitan, and these are *Periplaneta orientalis*, the common Black Beetle of England, and *P. americana*, the large, brown, long-winged species of this country. Mr. Tepper gives available synoptic tables of families, but unfortunately for the student publishes no tables of genera and species, and has also been unable to give illustrations. The publication is still a very valuable one, however.

AN INJURIOUS HAWAIIAN BEETLE.

Hon. I. Marsden, commissioner of agriculture and forestry of Hawaii, has sent us, among other interesting things, specimens of a Scarabæid beetle (*Adoretus umbrosus*) which he reports is rapidly becoming a most serious pest. They were first noticed about two years ago and were said to have been brought over from Japan. They are seen after dark in enormous numbers and riddle the leaves of many trees and plants. The genus is not represented in the United States, and it is unlikely that they were introduced from Japan to Hawaii, as they are not known in the former country.

THE SWEET POTATO WEEVIL IN JAMAICA.

In No. 47 of the "Notes of the Museum" of the Institute of Jamaica Prof. C. H. T. Townsend reports that on the island of Grand Cayman *Cylas formicarius* has been found attacking potatoes of all kinds, "but especially the large white variety." The insect has apparently been introduced from Cuba or Pedro (St. Elizabeth), where it

abounds. It seems that only tubers of a certain size are attacked, and early digging sometimes avoids the attack. Sandy soil and deep planting are said to be preventives to some extent.

THE "TOM RAFFLES" ANT OF JAMAICA.

No. 45 of the "Notes from the Museum" of the Institute of Jamaica contains an account by Prof. C. H. T. Townsend concerning the ant known popularly by the name of "Tom Raffles" in the British West Indies. It is *Formica omnivora*, and was brought to Jamaica from Cuba in 1762 by Mr. Thomas Raffles, who thought that it would devour the Jamaican ants and other noxious insects. It failed to do the intended work and became a pest itself. Prof. Townsend's note is one asking for information simply, as he is not aware of the present condition of the species on the Island of Jamaica.

AN INTERESTING OBSERVATION ON THE LARVA OF EPHESTIA KUEHNIELLA.

In the last number of INSECT LIFE we reviewed the elaborate investigation of M. J. Danysz, of Paris, on *Ephestia kuehniella* as a flour pest in France. The same author contributes to No. 7 of the *Bulletin des Séances de la Soc. Entomologique de France*, April 12, 1893, an interesting note upon the pigment spot (the embryonic testicle) of the larva of this insect. While searching for the natural enemies of Ephestia, M. Danysz's attention was drawn to a note published in 1887 by Mr. Archibald Geikie who reported the complete destruction of Ephestia in a flour warehouse in London by an Ichneumon (*Bracon brevicornis*), of which he figured the male and female. Mr. Geikie said in substance that he had noticed on the backs of the Ephestia larvæ a black spot, which he had not observed before, but paid no attention to it, thinking it a normal phenomenon in the development of the insect; but that some weeks later he was astonished to find on the sacks of flour which had been covered with the larvæ of Ephestia a great quantity of little black flies, and he then recognized the fact that the black spot was nothing else than the egg of *Bracon brevicornis*, the larvæ of which had devoured those of Ephestia.

M. Danysz then segregated a number of the Ephestia larvæ with the black spot upon their backs, in the hope of securing some of the Ichneumons, but his expectations were disappointed, for they all transformed successively to chrysalides and adults without presenting any abnormal features, while of the Ichneumons he did not secure a single specimen. His close observation of the black spot, however, furnished him with a very interesting observation.

The pigment spot in question is situated on the dorsal face of the fifth anal segment and lies under the cuticle, without attachment to it. By dissection he found it to consist of two reniform corpuscles placed in

the cellular tissue above the digestive tube and strongly colored with reddish-brown. Continuing his observations, M. Danysz was able to find the same organ, a little modified but sufficiently recognizable, in both the chrysalis and the adult; in the latter the two reniform bodies being united into a single ovoid body. In the adult also this ovoid body is connected by two long canals with the genital armature, and as, moreover, the larvæ with black spots always produced male adults, there is no doubt that Mr. Geikie's Ichneumon egg is simply a testicle in process of evolution. It is interesting to note that among insects which undergo complete metamorphosis, as is the case with Ephestia, there is generally histolysis of all the organs of the larva during the chrysalis stage; here, however, the testicle formed in the body of the larva continues to develop in the chrysalis while all the other organs undergo complete histolysis. It is perhaps the first example of a larva the different sexes of which are so distinctly marked by a character which is visible externally. M. Danysz proposes to complete his interesting observation by a more profound histologic examination.

THE CARNATION "TWITTER."

We have recently received an inquiry from Mrs. Celia Thaxter, of Isle of Shoals, concerning a new disease of her Carnation plants. An examination of specimens showed that the trouble was caused by an Anthomyiid larva working in the stems of the plants near the ground. Many plants were killed and we are now endeavoring to rear the adult insect. Mrs. Thaxter called our attention to a paragraph in Peter Henderson's Catalogue of Plants which evidently refers to this insect:

> The Carnation Twitter is an insect but little known and in this district only by its local name of "Carnation Twitters," given from its rapid and nervous motion. As seen by the naked eye, it is about the twentieth of an inch in length, and of a thickness not more than that of a needle point. It is of various shades of color, from green to black. It is never very numerous on plants, but most destructive, and evidently poisonous in its attacks on all varieties of the Carnation or Dianthus family. Its effects on plants somewhat resemble those of the Red Spider, except that when attacked by the Twitter the leaves have a cankered and twisted appearance, easily distinguishable from the browning effects of the spider, and it is far more destructive. We have often seen thousands of Carnation plants destroyed by it in a season. We regret to say that so far we have found nothing that will destroy this insect that does not at the same time injure the plant. We have tried tobacco in all forms, lime, soot, hellebore, Paris green, quassia, aloes, and all the nostrums usually baneful to insect life, without seeming in the slightest to disturb the Twitter. We have found, however, that its ravages are worse on light soils. On heavy stiff clay land we have never know it to do much injury.—[Henderson's Handbook, new edition, under insects, p. 204].

Are any of our readers familiar with this trouble, and can they send us additional specimens to assist in the full study of the life history?

A MEALY BUG ENEMY TO SUGAR CANE IN THE WEST INDIES.

We have recently received from Mr. Barber, director of agriculture of the Leeward Islands, two very interesting mealy bugs which are

found upon sugar cane on the island of St. Christopher. The one appears on the roots and the other in the axils of the leaves. Curiously enough, they appear to form two new species of a new genus near Dactylopius, which we hope to describe after further study on receipt of new material. The species on the roots, according to Mr. Barber, promises to cause a great deal of annoyance on estates not properly manured or cultivated. The young plants come up a sickly yellow or rusty color and require frequent replacing. They manage, however, most of them, to throw the pest off with the reproduction of fresh roots, so as not to suffer materially. Mr. Barber noted 37 acres severely attacked. The planters claim that lime and ashes are efficacious and also superphosphites.

ANOTHER EMASCULATING BOT.

Mr. F. Stephens, West Creek, California, sends us two "warbles" taken from the body of a parasite mouse (*Sitomys californicus*). Mr. Stephens trapped the mouse on the upper Temecula River in California. The warbles were found in the scrotum, with air holes in the back part of the same. On the rump was a small sore, which, on skinning, was found to contain another warble, dead and partly decomposed. Mr. Stephens thinks the mouse was able to reach this point with its head, and that it had killed the larva. The species is plainly Cuterebra, but differs from any which we have seen before, approaching, however, most closely to *C. emasculator* of Fitch, which occurs abundantly in the east in the axillary regions and near the genitalia of the Red Squirrel and Striped Gopher. Mr. Stephens has promised to try to rear any further specimens which he may find, and we hope that other observers in the same locality will watch for this interesting form.

THE EGYPTIAN ICERYA IN INDIA.

In our last number we announced the finding at Madras, India, of *Icerya ægyptiacum*, specimens of which we received through the kindness of Mr. Robert Newstead, of England. We wrote our correspondent, Mr. E. C. Cotes, of Calcutta, to ascertain whether the species was widespread in India, and he was fortunately able to find it at once upon Croton plants in the quadrangle of the Indian Museum. He also found it infested with secondary parasites identical with the form which we had received from Mr. Newstead, but was unable to find the primary parasite, which, however must exist and will undoubtedly be found in the near future. The scale insect does not seem to be particularly abundant in India, and its rapid multiplication in Egypt is probably due to the fact that the species is a comparatively recent introduction, and that it is an autochthon of India. Mr. Cotes finds that the Icerya is attended by an ant of the genus Cremastogaster, which he noticed busily prodding the scale insects with its antennæ.

A STRAWBERRY ENEMY IN JAMAICA.

No. 38 of the hektograph notes from the Museum of the Institute of Jamaica, begun by Mr. Cockerell and continued by Mr. Townsend, has just reached us. It concerns the damage done by a weevil larva which bores into the heart of the strawberry plant. Mr. Townsend considers this to be the larva of *Præpodius amabilis* Waterhouse, a large weevil, from 21 to 26 millimeters long. Applications of fresh lime and kainit have been partly successful. It is to be hoped that Mr. Townsend will succeed in working out the life history of this weevil in detail, as the strawberry growers of our Southern States may become actively interested in this new strawberry pest.

SILK-SPINNING CAVE LARVÆ.

In *Science* for July 21, 1893, Mr. H. Garman describes under the above title an interesting larva which he has found in a small cave near Lexington, Ky., and which he determines to be Dipterous. The larva spins a glistening thread on the wall of the cave, clinging to its thread by means of pads provided with minute chitinous asperities. The ocellar areas are diminutive. The available food seems to be occasional tallow drippings and molds found growing on the walls of the cave. The insect is mainly remarkable from its silk-spinning habit. We are informed, in conversation, by Mr. H. G. Hubbard that he has seen the same larva and has proved it to belong to the family Tipulidæ.

MIGRATORY LOCUSTS IN CHILE.

We have just received from Mr. Edwyn C. Reed, recently appointed official entomologist in Chile, an interesting paper published the present summer on the migratory locusts which have, during the past two or three years, caused considerable damage in parts of that country. Several districts have suffered a loss of from 25,000 to 30,000 pesos. The species is identified as *Acridium maculipenne* and the usual remedies are given. Several other species are briefly mentioned, namely *Acridium cancellatum*, *Batracopus tibialis*, *Tropinotus ornaticollis* and *Acridium vitigerum*.

THE COLORADO POTATO BEETLE IN NOVA SCOTIA.

It is now about four years since the Colorado Potato-beetle made its first appearance in Nova Scotia, and since that time the provincial crop reports have made frequent mention of its occurrence and the amount of damage it has done. The crop report for July, 1893, gives in some detail an account of the ravages of the insect during the early part of the season, from which it appears that in general the insects are not as numerous as during last year, the localities reporting the greatest damage being Granville Center, in Annapolis County; the Polling dis-

trict, Cumberland County; Windsor, Hants County; Cornwallis, Kings County, and South Queens, Brookfield, Pleasant River, Kempt, and Liverpool, Queens County. The history of this insect in Nova Scotia possesses considerable interest for the economic entomologist, since this is probably its northernmost limit as a crop pest.

ITALIAN WORK ON THE COCCIDÆ.

We have elsewhere referred to the admirable work which has been done in Italy during the last few years in regard to the life history of certain species of Coccidæ, and our attention has recently been called again to this matter by the current number of the *Rivista di Patologia Vegetale*, vol. II, March–June, 1893. This number contains three important articles upon bark lice. The first, which is by A. Banti, carefully figures and describes all the stages of *Aspidiotus ceratoriæ* Colv., and the second is by A. Berlese, upon *Mytilaspis fulva*, a species which has been doing much damage of late years in the mulberry groves of certain portions of Italy. The author summarizes the life history of the insect, giving excellent anatomical figures and a table of the means which have been used against it. The third article, which is even more pretentious, is also by Signor Berlese. It is the beginning of an extensive and careful monograph of the Italian Coccidæ which live upon citrus trees. The present number contains a detailed consideration of two species only, viz, *Dactylopius citri* Risso and *D. longispinus* Targioni-Tozzetti, these names taking precedence of those given by Comstock in 1880 to the same species—namely, *D. destructor* and *D. longifilis*. The thoroughness of the treatment may be judged from the fact that the consideration of these two species occupies 44 large quarto pages with 35 text illustrations.

THE PENNSYLVANIA LOUSE STORY ABROAD.

We have elsewhere referred to the exaggerated reports of the plague of lice in Lancaster County, Pa., which appeared in press dispatches during July. The stories had but the slightest basis in fact, as we have shown. It only requires distance, however, to enlarge a newspaper story to gigantic proportions, and an editorial writer on the London *Evening Standard* has succeeded in producing a paragraph based upon New York dispatches which is calculated to produce a veritable panic. From the single occurrence of a few specimens of the harmless *Atropos pulsatoria* in an old hat, the ingenious writer evolves a plague which is comparable only to the Biblical Egyptian occurrences in the times of the Pharaohs. In three days four townships were overrun, a panic arose, the people fled to a distance, and the infested localities were quarantined. At the date of writing it was stated that further particulars were awaited with intense anxiety in England, on account of the probability that the insect would overrun the States and make its appearance abroad!

THE MOSQUITO IN ENGLAND.

We have not seen any notice in any of our scientific periodicals of the fact that the true New Jersey mosquito has made its appearance in England, although statements to that effect have appeared in the newspapers. We are able to confirm this rumor from personal experience. A large and voracious species of Culex, indistinguishable casually from the species common about New York harbor, is to be found in London and is not infrequent in the large hotels. They were particularly bad in 1886 at the Grosvenor hotel, Victoria Station, and proved even more annoying to the Londoner than to the many American guests of the hotel. These insects are undoubtedly being carried over occasionally in the large ocean steamers, and the gradual reduction in the length of time of the voyage will undoubtedly result in an increase of such instances. A recent number of the London *Spectator* mentions the fact that in a large colliery in the north of England the men at work in a distant part of the mine complained that the galleries were full of mosquitoes. As ordinarily it takes something worse than a mosquito to frighten a collier, the manager went down to explore, and found large yellow-banded wasps in great abundance.

BRITISH PHYTOPHAGOUS HYMENOPTERA.

We have recently received the fourth and concluding volume of Mr. Peter Cameron's very valuable Monograph of the Tenthredinidæ, Siricidæ (Uroceridæ) and Cynipidæ of Great Britain. This last volume is uniform in style with the preceding ones, and, while dealing chiefly with the Cynipidæ, includes a very considerable appendix to the first two volumes, which were devoted to the Tenthredinidæ, or Sawflies. The preliminary chapter on the gallflies (Cynipidæ), giving the general biology of these insects, includes a discussion of some very interesting topics, such as parthenogenesis, alternation of generations, parasites, inquilines, etc. Of the greatest interest, perhaps, is the conclusion reached in regard to the origin of the wonderful galls which these insects produce in such remarkable variety and complexity. The author rejects the theory which we have hitherto urged, and which is generally accepted, namely, that the poison peculiar to each species of Cynipidæ, which is injected by the insect into the tissues of the plant at oviposition, is responsible for the distinctive gall resulting from the sting of the species, and adopts the theory of mechanical irritation induced by the birth and growth of the larva as the prime factor in their genesis. Without stopping to discuss this matter now, it is sufficient to state that we are by no means convinced of the soundness of the author's views, and still think a more satisfactory explanation is the one first stated. A valuable summary of food plants is also given, with synoptic tables of galls and genera, followed by a very full description of the species, giving life-history, habits, and synonymy. The appendix to

vols. I and II relates solely to the sawflies, and is introduced to include the many new genera which have recently been added in this group, together with the limitations of genera due to the very careful and extensive studies of F. W. Konow. Mr. Cameron has translated the descriptions of most of the new genera erected by Konow, and also portions of the latter's synoptic tables. He gives also elaborate notes on the resulting synonymy and generic placing of species, and considerable additions to the list of food plants published in the first volume of the work. The volume ends with a very extensive and valuable bibliography of the writings on Phytophagous Hymenoptera and a complete index to the volume. Some nineteen excellent plates are included, which give very fair representations of most of the British galls and gall-makers, while other plates show the structure of the galls in magnified section. Mr. Cameron is to be congratulated on the publication of this volume, which closes for him the labor of a good many years and gives to the world a most valuable and important monograph on perhaps the most interesting of the Hymenoptera. The work is a publication of the Ray Society.—C. L. M.

THE BUMBLEBEE IN NEW ZEALAND.

A recent writer in *The New Zealand Farmer* makes a somewhat extended argument to show that the accounts of the enormous increase of this insect in that colony are exaggerated. He does not deny the fact that a great deal of good has been accomplished by the introduction of the species in the way of fertilizing clover, but contends that it only takes a few bumblebees to make a considerable rumpus.

LEEWARD ISLAND COCCIDÆ.

The following is a list of the Coccidæ which Mr. C. L. Barber, superintendent of agriculture, has personally collected upon the Leeward Islands:

Aspidiotus sp. Areca rubra and Sabal. Antigua.

Aspidiotus articulatus. Vitis vinifera. Nevis.

Aspidiotus aurantii Mask. Limes. Montserrat.

Aspidiotus budleiæ var. fallax Ckll. MS. (Morgan makes it = nerii). Mango, Terminalia, Cinnamomum. Antigua.

Aspidiotus personatus Comst. Areca rubra and Sabal. Antigua.

Aspidiotus punicæ Ckll. MS. Cocoanut husks. Dominica.

Ceroplastes cassiæ Chavannes = Ckll. MS. C. burseræ. Bursera gommifera. Antigua.

Ceroplastes cirripediformis Comstock. Eranthemum. Antigua.

Ceroplastes denudatus Ckll. MS. Sour sop. Antigua.

Ceroplastes plumbaginis Ckll. MS. Plumbago alternanthera. Antigua.

Chionaspis minor Maskell? Capsicum. Antigua.

Ch. (minor var.?) angustior nov. Ckll. MS. Pigeon peas. Montserrat.

Chionaspis timidus Ckll. MS. Hibiscus (Morgan makes it = Ch. minor). Antigua.

Diaspis ? sp. (Single white ♂ scale). Tangerine. Antigua.

Diaspis lanatus Ckll. (Inst. Jam., 1892.) Chionaspis major Ckll. MS. in litt. olim. Heliotrope. Antigua.

Ichnaspis piliformis Dougl. Sabal, etc. Antigua.

Lecanium assimile Newst. var. amaryllidis Ckll. MS. = L. amaryllidis Ckll. in litt. olim. amaryllis. Antigua.

Lecanium begoniæ (Dougl.) = L. praternum Ckll. in litt. olim. terminalis. Antigua.

Lecanium depressum Targ.-Tozz. Hibiscus. Antigua.

Lecanium hemisphericum Targ.-Tozz. General on all garden plants. Cycas. Antigua, Montserrat.

Lecanium longulus Douglas, 1887. Pigeon peas. Antigua.

Lecanium oleæ Bern. Terminalis. Antigua.

Mytilaspis citricola (Packard) Comstock. Tangerine. Antigua.

Planchonia bambusæ—Ckll. MS. Bamboos. Montserrat and Dominica.

Planchonia pustulans Ckll. MS. ♀ Asterodiaspis pustulans Ckll. Pigeon peas, Oleander, Custard Apple, perillea Mangoes. Montserrat, Antigua also in Anguilla.

Vinsonia stellifera. Cudisia, Euferria malaccensis. Montserrat also in Antigua.

ACTIVE GRASSHOPPER WORK.

In June of the present season the people of Kern County, Cal., were threatened with a plague of the California Devastating Locust. Two sections of worthless mesa land were found to be full of grasshoppers and eggs. Familiar with the best methods to use against these insects, hopperdozers were at once constructed, and at a cost of $1.25 per acre the land was completely rid of the insects.

THE PEACH MAGGOT FLY.

The recent damage done to peaches in South Africa by *Ceratitis citriperda* still occupies the attention of fruit growers in that colony. The Agricultural Journal of the department of agriculture at Cape Colony, in its issue of May 4, 1893, publishes a very extensive article by Mr. S. D. Bairstow as a second instalment of his series of papers upon insect pests. Mr. Bairstow gives the life history of the species, and a lengthy series of correspondence with fruit growers in the infested regions, also two full-page plates devoted to illustrations of the different stages and enlarged parts of the insect. The two remedies consist in the collection and destruction of the infested fruit and the "perpetual turning out of the pupæ from the upper half spit of your orchard for such light infantry as fowls and turkeys."

CRICKETS OF INDIANA.

In the proceedings of the Indiana Academy of Sciences for 1891, recently published, Mr. W. S. Blatchley presents a paper on the Gryllidæ of Indiana, which gives careful descriptions of the different species of this interesting family which inhabit the State. The paper is important for the reason that this group of insects has been almost entirely neglected by North American writers, and good descriptions of even the commoner forms have hitherto not been accessible. The descrip-

tions are accompanied by brief accounts of the habits, in which a number of original observations are given. Sixteen species, none of them new, comprise the list.

FATAL SPIDER BITES.

It has been generally believed in Jamaica, from quite early times, that serious results will arise from the bites of certain spiders. The following testimony from Dr. Cargill, of Half-Way Tree, confirms this belief, and has value as an independent statement of one who has had long experience in the island. The Queue-rouge is, of course, the *Latro ductus*, which is not uncommon in Jamaica. In the original MS. the omitted names are given, but I have received permission to send it for publication on condition that I omit them. The Colon spider is one of the old genus *Mygale*.—[T. D. A. Cockerell (June, 1893).

It was supposed that the whitlow which ended in blood poisoning originated in a spider's bite (in Mrs. ———'s case), but I was never satisfied that such was really the case. People are very apt to mix up *post* and *propter hoc* occurrences. There can be no doubt that venomous spiders, such as the Tarantula and Black spider (the little red-tailed *Queue-rouge* spider especially), have occasioned death in rare instances, either by the direct lethal effects of their poison or by blood poisoning secondarily. I have never had any death from spider bite in my own practice; but I have had many cases attended with severe pain and serious inflammation of the joints of the fingers. Capt. ———'s first wife nearly lost a finger from a black spider bite, and the late Richard Hill (naturalist), an old friend of mine, told me that he had a friend who died from a spider bite on his tongue. The spider was a *Queue-rouge*, and had got between the blades of some guinea grass which he had put in his mouth. There is a very large spider in Colon, which the people call Antelope, but which is no doubt a species of Tarantula. This spider has been known to kill dogs and horses, and the bottle which contains a good specimen in our museum has a label which states that the spider was supposed to have killed a girl. We have many interesting spiders in Jamaica, and if I can get a red-tailed black spider I will send it to you. It is far more venomous than a scorpion.—[Jasper Cargill (November, 1891).

POPULAR NAMES OF THE HORN FLY.

In our original article upon this insect, when it had spread only from New Jersey down into Virginia, we stated that it was called indifferently the "Texas Fly," "Buffalo Fly," and the "Buffalo Gnat." Since then we have heard of but three new popular names. In Delaware County, N. Y., it is called the "Canada Fly," in Alabama the "Hessian Fly," while in the Southwest it is known as the "Third Party Fly." Correspondents will oblige us by notifying us of any further popular designations.

ANOTHER "BLOOD-SUCKING" CONE-NOSE.

We have received, through the kindness of Mr. John B. Lembert, of Yosemite Valley, California, a species of Conorhinus new to the national collection, and which Mr. Lembert has always found in or about beds. The face, hands, and feet of the sleeper are often bitten, causing

swelling and a smarting sensation similar to that occasioned by Poison Ivy, and which usually soon heals, but in some instances is said to break out again and cause considerable soreness.

HOP LICE IN NEW YORK STATE.

During the early part of June hop lice were very prevalent in some portions of Otsego County, N. Y., and a repetition of the damage of 1886 was for some time anticipated, but, as has so frequently happened, the natural enemies of the insect appeared in almost equal abundance, and by the first of July the danger was past. This was a more or less local appearance, since in Oneida County no lice were noticed. In England, on the contrary, considerable damage has already been done by the lice and more is anticipated, as we notice from the *Kentish Observer* of recent date.

THE GYPSY MOTH IN CAMBRIDGE.

The home of the father of North American economic entomology has been invaded by the destructive Gypsy Moth, which, in spite of the assurances of the Commission, seems to have been spreading in the State of Massachusetts. Recent examinations show the insect to have become widely distributed through the town of Cambridge, and many hiding places hitherto overlooked have been found. Large colonies had sought the shelter of the sanctuary of the church and a number of nests were found under the steps of St. James Episcopal Church, on North avenue. The inspectors have been energetic and doubtless have prevented a serious plague, but they seem by no means to have succeed in eradicating the pest.

An interesting feature of the work of the past season has been a children's crusade, instituted at Hingham by the Agricultural and Horticultural Society. It is reported that seventy-five children were engaged in the work and they collected a total of 68,006 egg masses, representing at least fifteen millions of caterpillars. Prizes were awarded to the five who collected the greatest number.

A HOME-MADE SPRAYER.

We notice an interesting article in a recent issue of the *Kansas Farmer* describing at some length how a farmer can make an effective sprayer for himself which will be sufficiently powerful and capacious to spray a large orchard, while the total cost to make it, including the pump, will be only $13. The apparatus is very similar to the one which we have several times described in our reports, and which is figured upon Plate I of Bulletin 6 of this Division. It consists simply of a kerosene barrel mounted upon skids, with a strong force pump inserted above. Two or three points of importance were brought out in our description which have not been touched upon by the *Kansas Farmer* article, but the latter

is none the less valuable, and the attention of farmers and fruit growers should be drawn to the extreme ease with which a satisfactory spraying apparatus can be knocked together by any person with even a slight ability at handling tools. Such an apparatus is likely to be even more convenient and useful than the high-priced machines placed upon the market by manufacturers.

SILK CULTURE IN HELENA.

We notice that Governor Grey-Wilson, in a recent report to the Colonial Office, states that experiments are being carried on in the rearing and breeding of silkworms in the island of Saint Helena. The results so far obtained are said to have been very encouraging, and many thousands of mulberry trees have been set out. Rev. J. H. Daine, the resident Roman Catholic chaplain, is taking a very lively interest in the attempt, and has imported eggs from the Cape of Good Hope and from France.

THE HORN FLY IN ALABAMA.

The *Mobile Register* of June 10 devotes half a column to the subject of the sudden appearance of the Horn Fly in the northern portion of Mobile County, where stock raisers have invented a new popular name for it in "Hessian Fly," which the *Register* spells *Heschian*. The account gives the remedies which have been proposed by entomologists, and makes sundry misstatements, the most remarkable of which is, "from a single dropping will often issue more than 500 new flies within a few hours." The Horn Fly develops rapidly, it is true, but those who are familiar with our published accounts will recognize that this statement is, to say the least, somewhat exaggerated.

DAMAGE BY CHINCH BUGS.

At the present writing (July 7) the season of 1893 appears to be a favorable one for Chinch Bugs. Reports of great damage have come to us from parts of Kansas, Oklahoma, and Texas. In all these localities the injury has been aggravated by more or less severe drought. At two points diseased bugs from the State University at Lawrence, Kans., have been introduced, but, as we have been informed, without result, and we predict that the fungus and bacterial diseases will appear almost if not quite as soon in other localities. A change in the weather, with a wet spell, will induce the rapid appearance and propagation of both bacterial and fungus diseases.

ECONOMIC IMPORTANCE OF CHALCOELA AURIFERA.

Judge Lawrence C. Johnson sent us lately a wasp's nest which he had found, and called attention to the fact that its original builders had been ousted by a small Lepidopterous insect, which, upon examination,

proved to be *Chalcoela aurifera.* The observation is not a new one, but is recorded here because in this case it takes on economic importance. Judge Johnson writes that young wasps form the best perch bait, and their destruction by the Chalcoela thus interferes with an industry which, anglers will admit, is already attended with many drawbacks.

LEEWARD ISLANDS ENTOMOLOGY.

Elsewhere in this number we publish a list of the Coccidæ collected personally by Mr. C. A. Barber, superintendent of agriculture of the Leeward Islands, and we have now to acknowledge briefly the receipt of two interesting publications from his department. Mr. Barber has interested himself very greatly in the subject of the insect pests of the different islands of the Leeward group, and is doing excellent work. He publishes in the supplement of the Leeward Islands *Gazette*, which appears to be issued every Thursday. On June 22 a note appeared concerning the destruction of the coffee scale by fungus in Montserrat. The fungus has not been determined, but Mr. Barber is making efforts to introduce it into the island of Antigua. The supplement for June 29 contains a long report upon an outbreak of the shot borer of the sugar cane in the island of St. Christopher. Mr. Barber has recently investigated the outbreak very thoroughly, and his account, which covers fifteen pages of the *Gazette*, contains reprints of his circulars of information and his conclusions from his observations. The interesting fact is noted that the area of cultivation of Jamaica cane is the area of immunity from the shot borer. The principal recommendations of Mr. Blandford are indorsed.

AUSTRALIAN SUGAR-CANE INSECTS.

On pages 385–389 of vol. IV, INSECT LIFE, we published an article by Mr. Koebele on sugar-cane insects in New South Wales. The article was based upon observations made by Mr. Koebele in January, 1891, in the fields of the Colonial Sugar Company, from the Clarence to the Tweed River in New South Wales. The insects considered were (1) the larva of a Noctuid; (2) Scarabæid larvæ; and (3) Wire-worms, or Diabrotica larvæ. None of the insects were mentioned by name. In the *Agricultural Gazette of New South Wales*, part 5 of vol. IV, May, 1893, Mr. A. S. Olliff publishes a report on the insects affecting the sugar-cane crop on the Clarence River. In this report Mr. Olliff treats of the damage done by insects and gives technical descriptions of the species observed, accompanying the article with a full-page plate. The undetermined Noctuid mentioned by Mr. Koebele is described by Mr. Olliff as *Nonagria exitiosa* n. sp. Its parasites are described as *Apanteles nonagriæ* and *Euplectus howardi.* The different stages of *Cryptamorpha desjardinsii* Guerin and of *Brachypeplus binotatus* Murr. are described, the former being a predatory beetle and the latter a fungus-eating species. The larva supposed by Mr. Koebele to be Diabrotica is considered

by Mr. Olliff to belong to either Aulacophora or Monolepta, since the genus Diabrotica is not known to occur in Australia. The larvæ referred to by Mr. Koebele as undetermined Scarabæids were found by Mr. Olliff to belong to *Anoplognathus concolor*, *Lepidiota squamulata*, *Lepidoderma albohirtum*, and to an undetermined species of the genus Heteronyx. These larvæ, however, he did not find numerous or destructive.

THE BLACK PEACH APHIS IN NEW YORK.

In Bulletin 49 of the Cornell University Agricultural Experiment Station, Mr. M. V. Slingerland announces the appearance of the Black Peach Aphis (*Aphis persicæ-niger*) in Niagara County, N. Y. Mr. Slingerland follows this announcement with a compiled account of the habits of the species.

THE PURPLE SCALE IN CALIFORNIA.

The excitement in southern California of a year ago, over the importation of *Mytilaspis citricola* upon cuttings, will be remembered by some of the readers of this journal. The general consensus of opinion was that neither this scale nor the Long Scale (*M. gloverii*), was likely to obtain a foothold on the Pacific coast. According to the *Rural Californian* for September, however, the Purple Scale is now an established pest in one or two localities in Los Angeles County. We have not the exact facts, but see no reason to doubt the statement. It will be interesting to ascertain whether the conditions of dense shade and consequent moisture, so favorable to its development in Florida, hold in those localities in southern California in which it has appeared. So far as we know the genus Mytilaspis has no native representatives on the Pacific coast, but *M. pomorum* and one or two other species have shown themselves to be readily adapted to almost any climate.

INSECTS IN THE HUMAN EAR.

We are indebted to Mr. J. B. Nelson, managing editor of the *Post-Intelligencer*, Seattle, Wash., for the following clippings. Mr. Nelson states that both stories are well authenticated. The insect is probably *Lucilia macellaria:*

Toledo, September 1.—John McKune, a rancher and logger residing near Ladew post-office, is the subject of a queer affliction. While driving home from town one evening last week he felt a bug or fly of some kind strike his ear and crawl in. He endeavored to remove it, and supposed he had done so. A few days later his ear began to pain him, and he thought he could feel something crawling within. It became unbearably painful so he prevailed on a friend to pour the ear full of turpentine. The effect was magical. Twenty maggots came from the ear. A number of persons witnessed the exit of the maggots. Dr. Green was called and concluded that the fly had remained in the ear long enough to "blow," possibly, a score inside the ear, though the man thought the ear perfectly well. The victim is recovering, and the ear appears not to be affected.

Spangle, Wash.—William Weaver has a young man working for him who has been troubled for some time with a sore ear. Last Monday Mr. Weaver persuaded the

boy to let him examine his ear. He poured in some sweet oil, then took a straw and made a careful examination, after which he laid the boy on his side, and much to his astonishment about 150 maggots came out of his head and dropped onto the bench. The supposition is that a blowfly had gotten into the boy's ear some time while he was asleep and the maggots had hatched out and crawled into his head out of sight, thus causing him much pain. The boy had worked hard during the hay harvest, and was not willing to consult a doctor, although after the above discovery he was persuaded to do so.

A NEW PAPER ON SCALE INSECTS.

In the Transactions of the New Zealand Institute for 1892, Mr. W. M. Maskell, the well-known writer on Coccidæ, publishes a long article giving descriptions of a number of new species and notes upon a number of described forms. Perhaps the majority of the species were collected by Mr. Koebele on his recent journey to Australia. Scattered through the paper are a number of notes of considerable interest upon species already described. We note, for instance, that the Orange Chionaspis (*Chionaspis citri* Comst.), which is the commonest Orange scale in Louisiana, occurs also upon Citrus plants in the island of Tonga, in the South Pacific. Comstock's Camellia Scale (*Fiorinia camelliæ*) described from specimens found in Washington greenhouses, occurs also on Palms in Australia and on plants of the genus Leptospermum. *Parlatoria proteus* Curtis is found also upon the Apple in Queensland. Mr. Maskell considers that *Lecanium hesperidum* and *L. lauri* are identical. He is driven to this conclusion not only by the lack of good distinguishing characters, but by the fact that the English food plants of the two species are reversed in Australia and New Zealand, *L. lauri* attacking Citrus plants in the latter colonies, while *L. hesperidum* lives upon Laurel, Ivy, Holly, and other plants. *Lecanium tessellatum*, previously known only upon Palms in the hothouses of Europe, occurs upon Laurus in Australia, and *L. acuminatum*, previously known on hothouse orchids in Paris, is found upon Guava in the Sandwich Islands. A new species of Icerya is described under the name of *I. koebelei*, from specimens collected in Australia by Mr. Koebele upon Leptospermum. It is closely related to *I. purchasi*, but carries an erect dorsal pencil of wax and has invariably ten-jointed antennæ and a very small ovisac in the adult female. This is the seventh species of this genus to be described. The paper is accompanied by plates drawn by the author.

Mr. Maskell's papers on the insects of this subfamily are authoritative. He has worked upon them now for fifteen years, and has done almost the sole descriptive work upon the very rich Coccid fauna of Australasia. We can not, however, refrain from incidentally reiterating our criticism of the etymological form of his group names. He is the sole author who uses them, and they are distinctly in violation of the formulated rules of zoölogical nomenclature. There can be no sufficient reason for their perpetuation, and we earnestly hope that Mr. Maskell will see the necessity of falling into line with other zoölogists.

NOTES FROM THE MUSEUM OF THE INSTITUTE OF JAMAICA.

We have recently received from Prof. Townsend Museum Notes Nos. 42, 43, and 44, dealing with various entomological matters of interest on the Island of Jamaica. No. 42 adds a new scale insect to the local enemies of the vine in *Diaspis lanatus*, which has been found very abundantly upon the grape about Kingston, but which has a wide range of food habit. In No. 43 an enemy of the Casuarina tree is recorded, this plant having been supposed hitherto to be free from insects. The pest is a twig-girdler, *Oncideres pustulata*, a native species, as identified by the Entomologist from specimens received through Mr. Fawcett from Little London. No. 44 is a general note regarding the plague of ticks which the island is now suffering from. The species is doubtfully referred to *Hyalomma dissimile* Koch, and request is made for the sending of specimens. Mr. Townsend intimates that the excessive abundance of the tick is probably due to the interrelations of the Mongoose with the natural enemies of the tick, viz, native birds, reptiles, etc., and he suggests that the tick may be controlled by the importation of these natural enemies or the artificial breeding and encouragement of the native ones.

We may add, in supplement to Note 43, that in Australia Casuarina has a number of insect foes.

NOTE ON CEUTHOPHILUS EATING CURTAINS AND OTHER FABRICS.

In a note in INSECT LIFE (April, 1893, pp. 222–223) my statement made in the *Canad. Entom.* (January, 1893) that *Ceuthophilus pallidus* frequently eats holes in lace curtains in southern New Mexico, is questioned as abnormal and accidental. I can only reassert that it has been reported to me on several occasions as doing such damage, specimens of the insect seen in the act accompanying the information. I have also found it doing the very same injury in my own house in Las Cruces. The species is quite often found within doors in that region in the summer months.

As further confirmatory of my previous statement, I may quote the following information on an allied species, taken from a letter which was written me by Mr. Cockerell:

"I believe I told you that *Ceuthophilus pallidus*, which you reported eating curtains in New Mexico, had similar habits in Colorado. On looking up my notes I find it was not *C. pallidus*, but *C. maculatus* I was thinking of. *C. maculatus* was complained of as eating various clothes, etc., which had been hung out to dry after washing. It is a species of the higher altitudes (7,000 to 10,000 feet). I did find *C. pallidus* in Colorado, but only in the foothills of Pueblo County."—[C. H. Tyler Townsend.

SPECIAL NOTES.

Association of Economic Entomologists.—The bulk of this number is taken up with the Proceedings of the recent meeting of the Association of Economic Entomologists held at Madison, Wis., August 14, 15, and 16. While the attendance at this meeting was not as large as that at the very successful Washington meeting two years ago, sixteen active members were present and twenty-nine papers by eighteen authors were presented. The papers thus exceeded in number, and were, on the whole, more important and interesting than at any previous meeting. Five of them were from foreigners. The discussions were of great interest, and it is a matter of regret that they could not have been more fully reported. The Society has every reason to congratulate itself.

Handbook of Victorian Insects.—Some time ago we noticed the publication of Part I, "Handbook of the Destructive Insects of Victoria," by Mr. Charles French, the government entomologist at Melbourne. Part II of this work has just reached us. It is a handy volume of about 200 pages, illustrated by twenty-one full-page colored plates and by eleven black and white plates of machinery. The plates are, many of them, original and some are extremely good, particularly those of the larger Lepidoptera and Coleoptera. The smaller Hymenoptera and Hemiptera fail, however, in general appearance and in detail. The colored work is very good. Many of the species treated are peculiar to the Australian fauna, but their careful treatment is none the less important to us in the United States, since many, if not all, are liable to be imported into this country. Several insects common to both regions are considered, viz, the Black Peach Aphis (*Myzus cerasi*), the Plum Curculio (*Conotrachelus nenuphar*), the Cottony Cushion-scale (*Icerya purchasi*), the Oleander Scale (*Aspidiotus nerii*), the Red Scale of California (*Aspidiotus aurantii*), the Purple Scale (*Mytilaspis citricola*), the Grapevine Phylloxera (*Phylloxera vastatrix*), the Potato-tuber Moth (*Lita solanella*), the Diamond-back Cabbage-moth (*Plutella cruciferarum*), and the Cabbage Aphis (*Aphis brassicae*). Mr. French con-

fesses to some uncertainty as to whether the Plum Curculio really occurs in Australia, and the article is introduced upon this uncertainty. As in Part I the volume concludes with some consideration of fruit and grain-eating birds and lists of materials for the destruction of insects and of insecticide machinery. The volume marks a distinct advance upon its predecessor, particularly in the illustrations, which are reproduced in a very superior manner. Original drawings were made by Mr. C. C. Brittlebank under Mr. French's direction.

Manual of New Zealand Entomology.*—We have not before noticed Mr. G. H. Hudson's interesting book published under the above title last year. It is a handsome little volume of 120 pages and with many colored plates, nearly all of which are well executed. The work consists of some observations on the anatomy of insects in general, a popular definition of the seven Linnean orders, a chapter on methods of collecting, and a systematic consideration of certain types of families arranged according to classificatory position. By a rather curious arrangement this consideration begins with the Coleoptera and ends with the Hemiptera. The author seems to have made a large number of important personal observations on the life histories of different species. Owing to the restricted size of the volume only a small proportion of the families are thus considered, but as a general thing the accounts are full and presumably accurate and at the same time are written in a most interesting and rather popular style. Every insect treated is figured upon a colored plate, usually in the larval stage and sometimes in the pupal stage as well as in the adult. This method of taking a single type of each family treated is, perhaps, as good a one as could have been chosen for a work of this extent. The insects are many of them strange in appearance and some of the observations upon life histories are new to science. The only matters in the volume which are open to criticism are the ancient classification and certain mispelled family names. The book is well calculated to excite an interest in entomology and this is the avowed purpose for which it was written.

*An Elementary Manual of New Zealand Entomology for Introduction to the Study of our Native Insects. With twenty-one colored plates. By G. V. Hudson, F. E. S. Wellington, New Zealand. London. West, Newman & Co., 1892.

FIFTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

FIRST SESSION—AUGUST 14, 1893.

The Association met at 2 o'clock p. m. in Room 24, Science Hall, University of Wisconsin, Madison, Wis., August 14, 1893. The following officers and members were present:

President, S. A. Forbes, Champaign, Ill., second vice-president, J. B. Smith, New Brunswick, N. J.; secretary, H. Garman, Lexington, Ky.; J. M. Aldrich, Moscow, Idaho; G. F. Atkinson, Ithaca, N. Y.; G. C. Davis, Agricultural College, Mich.; C. P. Gillette, Fort Collins, Colo.; A. D. Hopkins, Morgantown, W. Va.; L. O. Howard, Washington, D. C.; M. E. Murtfeldt, Kirkwood, Mo.; H. Osborn, Ames, Iowa; C. V. Riley, Washington, D. C.; P. H. Rolfs, Lake City, Fla.; H. E. Summers, Champaign, Ill.; F. M. Webster, Wooster, Ohio; H. E. Weed, Agricultural College, Miss.

A number of visitors and members of other scientific associations were present during the session.

The call to order was followed by the delivery of the annual address of the president.

PRESIDENTIAL ADDRESS.

By S. A. Forbes, *Champaign, Ill.*

Gentlemen: It is my present pleasing duty to set in motion the machinery of this Association of Economic Entomologists for what is apparently to be the most important meeting we have ever held. No one acquainted with our field can look over the titles which our secretary has brought together for his preliminary program, or the names of those eminent in entomology and in its economic applications who have consented to prepare papers on these subjects, without recognizing the fact that this is an exceptional meeting; and I heartily wish that your choice might have fallen for this time upon either an older or a younger entomologist for the presentation of a general address; either upon one of those who have practically covered in the period of their careers the development of economic entomology in this country, and so might have brought to us the results of the fullest and most fruitful experience, or upon one of that interesting group of younger

men becoming each year more numerous and influential in our circle who, coming to their work with a finished scientific and technical training impossible to any here but a few years ago, might represent more fitly and fully than any other the future of our science, whose development they are hereafter to have in charge.

But fortunately we have this year both Moses and the prophets with us, and whatever shortcomings you may find in your temporary representative, who is neither one nor the other, but at most a little of both, you will be able easily to make good as this meeting goes on.

The literature of economic entomology in this country is so rapidly increasing that a full annual synopsis of it, readable within the limits of such an address of mine, is no longer possible, if, indeed, it was ever desirable. Taking into account the fact that American economic entomologists are working each by and for himself, altogether without general supervision, and commonly without mutual consultation or coöperative plan, and the consequent fact that our investigations are as a whole extremely heterogeneous, determined in each case largely by personal bias and local circumstances instead of by common objects and a general view, it has seemed to me that I might do you some service by scanning the field of our operations, and so classifying the results of our work as to give you a clear, if incomplete, idea of the drift and balance of our progress for the year.

I have consequently gone, with some care, over one hundred and fifteen economic articles, long and short, published by us since our last meeting, omitting all which contain no new matter and making my selection according to geographic distribution and practical importance. These articles I have grouped by subjects and by nature of outcome; and I beg to present here in very general terms the results of my examination, in the hope that I may help you not only to see—according to the slang phrase of the day—just "where we are at," but also to throw some indirect light upon the more important question, whither we ought to go next. It seems to me that if we are to move hereafter as we have done in the past, as a body of irregulars rather than an organized soldiery, an annual survey of our field, such as will help us to keep somewhat in line, or at least within supporting distance of each other, should save us much confusion of effort and some loss of time and opportunity.

In the first place, I have to observe that we seem from our publications fairly well satisfied as a body with our present methods of investigation and report; or, if not satisfied, then at any rate not in a condition now to improve upon them. I have not come anywhere upon any new method of research adopted or proposed in field or laboratory, nor seen in any of our publications any notable departure from the stereotyped form of printed article which has become habitual with us. Perhaps this is because—absorbed as we are in subjects—these matters of form and method receive less attention from us than they really

deserve. More likely it is because our economic papers do not fairly reflect our progress in this respect, and it may be that if we were to exchange ideas and experiences upon these topics at this meeting we should find ourselves able to improve each other's practice materially.

A similar statement may be made respecting new economic methods also; that is, new methods of prevention and remedy applicable to insect injury. We are generally busying ourselves with those we are already acquainted with, or, at most, with unimportant modifications of the old, and have this year proposed nothing radically new.

The insecticides and apparatus for their distribution are still prominent in our work, but I have nothing to report in the way of new insecticide apparatus or of new insecticides, unless Bruner's suggestion of corn meal for the Cabbage Worm may be mentioned under the latter head. Twenty articles giving new results of experiments with standard insecticide substances are on my list, the freshest and most notable of which are three on the destruction of insect eggs, by Cook, of Michigan, Smith, of New Jersey, and Slingerland, of Cornell. Others relate to cabbage worms, white grubs, the grass leaf-hoppers, the codling moth, the cutworms, the granary insects, and so on. The Bordeaux mixture has been further tried for entomological purposes, as reported by Garman of Kentucky, and a single combination experiment with insecticides and fungicides is described in the Cornell Bulletin. Slingerland's careful trap-lantern experiments (*Canadian Entomologist* for March) may also be mentioned here.

I find six references to the importation of insect parasites sufficiently important to deserve our notice, most of them, as heretofore, contributed by the United States Division of Entomology; one, however, by the West Virginia Station, whose Entomologist, Hopkins, visited Europe with a view to the special importation of the parasitic enemies of insects infesting forest trees.

The fungous diseases of insects seem to have received but little attention during the year, if one may judge from the slight and infrequent contributions to this subject. Almost the only item of special interest I have seen is an account of an unsuccessful experiment to destroy the American white grub by means of Giard's *Isaria densa*, a fungous parasite of the *vers blanc* of France, sufficiently prevalent there to have been cultivated artificially on a large scale and offered for sale to farmers. I may say here that our own experiments with this fungus, made last year, were moderately successful in the laboratory, where gelatine cultures were made without difficulty, and various species of melolonthid larvæ were infected successfully by dusting with ripened spores; but diseased white grubs placed in the earth with healthy ones did not convey the infection.

General agricultural methods have been quite fully discussed by Smith for cranberry insects in his bulletin for December, 1892, but I think by no one else; and some curious observations on the effect of

various kinds of fencing upon the distribution and abundance of certain economic species were reported by Webster in "*Science*" for December, 1892.

Coming now to the more strictly entomological part of the work of the year, we notice the discovery of three or four injurious species new to science,—as yet of little economic interest, however,—and a considerable number of species previously known but reported for the first time as injurious; one (a Crambid) to Corn, three to Cabbage, one an osage orange species, one infesting Wheat, another the Beet, still others the English walnut and other trees, two affecting the Peach, and one from Oregon attacking that and several other fruits. That katydids injure cranberries was, I think, previously known, but the amount and method of their injury has been methodically studied by Smith.

Among beneficial species, the insect parasites of scale insects have been most fruitfully investigated and two new forms described, and other new parasitic species have been bred from the strawberry weevil, the western locust, and so forth. Specially noteworthy are papers by Webster and Ashmead on parasitic Hymenoptera of Ohio, several new forms of which are economic.

In the department of life histories and habits,—the basis, as all will admit, of our economic work,—a suitable activity has been manifest. Besides matter of this description contained in monographic and complete accounts of various species presently to be mentioned, I have noticed no less than twenty articles making valuable contributions to life histories of economic species, prominent among which are articles on the White Grubs (Perkins), the Strawberry Weevils (Beckwith and Chittenden), three species of the Grass Leaf-hoppers (Osborn), the Elm-leaf Beetle (both Riley and Smith), the Bud Moth (Slingerland), and a Crambid christened by Miss Murtfeldt the Blue-grass Worm. Slingerland's experiments on the possible number of annual generations in a plant louse species are deserving of special mention here.

In this connection may be noticed a few items of various importance on the subject of the gradual extension of introduced insects—the Horn Fly being most frequently mentioned.

The single species, or larger groups, which have been deemed worthy of summary, and usually of exhaustive, treatment from the economic pointof view, in papers aiming to bring together and present in résumé the essentials of their economic entomology, and containing new matter also, are the Bud Moth, the Cattle Tick, the Pear Leaf-mite, the Strawberry Weevil, the Black Peach Aphis, certain of the Sawflies, and the Scolytidæ of West Virginia.

The special plant groups whose insect enemies have been summarily and comprehensively discussed in a special paper for each group are the shade and ornamental trees of Nebraska, the small grains of Ohio, and the Blackberry and Raspberry in the same State. Here may be

mentioned also Webster's special notes on insects infesting the roots of Wheat, and Smith's work with Orthoptera in the cranberry field.

Further, the food of the Robin has been overhauled again in Ohio and that of gophers in South Dakota, both subjects entomological in their main interests; the relations of the codling-moth injury to apple rot have been studied in Kentucky, apiary experiments have been continued in Michigan, and a multitude of minor matters have claimed attention here and there.

In the critical remarks which I now propose to make, not so much on the nature as on the scope of our recent work, I trust that I shall not be misunderstood. It would be easy and pleasant to spend the time remaining to me in commendation and congratulation, but, I venture to think, less profitable in the end than to take these for granted and to look deliberately for deficiencies and for means of betterment. Undoubtedly, as it seems to me, so young an association, made up so largely of young men, should thoroughly criticise itself, its plans, its operations, and its tendencies, from time to time, with a view to giving its methods and its traditions an early set in exactly the right mold. And so, with the understanding that the comments I have here to offer are to be taken merely as my individual suggestions for your consideration, I venture to call your attention to some defects, as they appear to me, in our methods of report and publication; to certain failures of practical result and their remedy, and to a noticeable narrowness of view and consequent lack or inadequacy in our treatment of general questions, due to the want of comprehensive organization and systematic coöperation among us.

It is not the wealth one gathers, but that which he puts to use, which makes him rich. It is not the knowledge we acquire, but what we succeed in making application of, which makes us wise. It is not the facts of entomology we discover, but those which we persuade the farmer, the gardener, or the fruit-grower to use diligently for the protection or the preservation of his crops, which make our entomology economic. To discover without publishing effectually is to waste our time as servants of the public. To publish valuable results without making sure of their appreciation and appropriation by our constituents is to fail of real usefulness and the reward of usefulness. To bring a result to bear on the practice of one man only, when a thousand are suffering for the want of it, is to fail in ninety-nine and nine-tenths per cent of our proper undertaking. We must first do exact, exhaustive, conclusive, practical, economic work, and then we must find means to get that work utilized or it is an economic dead loss.

Our methods of report and publication, of dissemination and enforcement, are, in my judgment, lagging far behind our methods of research, and are receiving far too little attention; so little, indeed, that I do not remember that this topic has ever been effectually discussed at any one of our meetings. And yet, since it is the object of these methods

to give real effect to all our work, it seems to me that this topic is equal in practical importance, not to any other merely, but to all others taken together.

I need only appeal to the experience of any of our older entomologists for abundant evidence that the methods of statement, publication, and enforcement now generally made use of fall far short of their final end. Take the literature of the Hessian Fly and of the Chinch Bug as examples. Has the general average agricultural practice of regions overwhelmingly infested by these insects been really modified materially by all our work and writing, or does it go on substantially as it did fifty years ago? We have made a deep and decided impression, here and there, beyond a doubt; frequently, however, by merely seconding the efforts and sifting and substantiating the evidence of the farmer, as in modern methods for the Codling Moth and the Curculio; but the farmer has not responded with anything like the same readiness and perseverance to the suggestions of the investigating entomologist; and means of reaching, instructing, and persuading him should be carefully studied and discussed by us with a view to their radical improvement.

After this preface I hope that you may receive with patience a few suggestions on this subject, drawn from my own ten years' experience as an official entomologist.

In the first place, I am inclined to think that we are very likely to forget, when we prepare our reports, that we are writing largely for men to whom entomology is a perplexing, obscure, and displeasing subject, of which they know little or nothing, and especially nothing good; but that on the other hand, they are frequently experts in crop inspection, far quicker, as a rule, to observe injuries to their crops than we are, and more likely to discriminate them nicely. If we had always borne this fact in mind, I think that our economic articles would usually have taken quite a different form. The crop injury and its characteristic appearances would have led in our discussions, and remedial and preventive measures would have followed thereupon as immediately as practicable, the insect itself being brought in, if at all, in a strictly subordinate way, as an aid to the recognition and classification of the injury, and as a guide in some instances to the selection of an economic method. Now, all but invariably, we put the insect and its characters, its habits, and its life history in the foreground, and make everything else depend upon a knowledge and recognition of these. In short, in dealing with insect injuries to agriculture we have commonly insisted that the farmer must become an entomologist, at least so far as agricultural insects are concerned, whereas, in fact, the practical entomologist should have first become a farmer, at least so far as is necessary to a detailed and critical knowledge of insect injuries to crops and to the application of agricultural methods of procedure for their control. How far we have come short of this

requirement no one can fully know who has not attempted to cull from the literature of economic entomology good and complete descriptions of crop injuries due to insects.

It is especially in synoptical and monographic articles, on all the insects of a single crop that this defect of treatment is most manifest. The insect enemies of the Apple in a single State may number more than two hundred, as in Illinois, while the list of distinguishable injuries to this fruit, classified with reference to differences of treatment, preventive and remedial, is less than a tenth as many; and every orchardist will be glad to know these critically and to act upon this knowledge, while he will almost certainly balk at the requirement that he should become thoroughly and practically acquainted with so many insect species as a condition of success in apple culture. It will be a great step forward in our attempt to popularize the results of economic work and to make them immediately and practically useful, if we can convince those for whose special benefit it is done that one does not need to become an expert entomologist to obtain from economic entomology the greater part of the benefit which it has to offer to the practical man—a step which I believe can only be taken by habitually putting to the front in our articles, and especially in our synoptical discussions, insect injuries, their full and precise description, their classification and treatment, as the principal features, bringing in the insects themselves—their description, habits, life histories, and the like—as secondary and subordinate matter, to be avoided, indeed, entirely, unless there are cogent reasons for its use. The acceptance of this idea would lead to the bringing together from time to time of all the literature of economic entomology for each crop or class of crops; to a critical overhauling of it from this strictly practical standpoint; to a good deal of field observation and laboratory experimentation for the preparation of fuller and more accurate descriptions and illustrations of insect injuries than are now current; and especially to the breaking up and melting up of a great mass of entomological knowledge and the recasting of it in the agricultural mold.

I think we should further distinguish in our publications and reports between what we may call temporary and permanent presentation. If we would reach the actual farmer with our publications it is useless to depend for any permanent influence on miscellaneous collections of articles such as make up the bulk of our bulletins and reports. They may be read occasionally as received—at least such parts of them as chance to treat of matters specially and locally important at the time—but they will soon accumulate from various sources as a heterogeneous mass, with neither beginning nor end nor index, from which our farmer friends are little likely even to brush the dust. We should hence make regular provision, in my judgment, for the preparation of special economic summaries or monographs of all insect injuries to each of the various crops, agricultural and horticultural, prominent in this country,

and should see that these are printed and distributed in numbers which might be called enormous as compared with those now commonly issued. As the preparation of such monographs is a great and irksome labor, wasteful of the time of the investigator, and yet requiring a conscientious thoroughness which only the investigator is likely to devote to it, and as the work once well done by one need not be done again, but may be made available for all, it seems to me that this is a matter which our association should take up through some general standing committee on coöperation, or by means of some less formal agency of subdivision and assignment.

I hardly need repeat that in these synoptical articles the thoroughly practical method of treatment and presentation is called for most of all. They should be articles on crops and not on insects, and should be written from the standpoint of a farmer turned entomologist, rather than that of an entomologist vainly trying to see through a farmer's spectacles.

The *viva voce* presentation of entomological matter at the farmers' institute, with its opportunities for explanation and illustration, for question and answer, and for the off-hand discussion of subjects of living interest to the time and place, is a new agency for the distribution of economic information which none of us will neglect. It has, however, the disadvantage that its utility depends on correctness of apprehension and accuracy of memory on the part of those little accustomed to take and hold instruction from the living teacher. I will, myself, never give another farmers' institute address, if I can help it, which is not followed up with a printed résumé, distributed to the audience.

But, now, supposing full and accurate information widely disseminated and in the actual possession of those for whom it is especially designed, we have next the most difficult task of all: to make sure that it will be practically applied. What shall we do and what advise to secure a common action in accordance with known and admitted facts? Shall we leave this to the individual and to the coercion of neighborhood opinion, or, these failing, shall we look to the law and to agencies established under the law? In short, are we practically individualists or socialists in our leanings? The official entomologist, I need hardly say, need not shrink from the word socialism, for as a Government official he is himself a socialistic product; as much so as the experiment station or the public school. Without attempting here to debate so large a question, I venture to express my own opinion that we should look to the law and to some regularly established system of inspection and penalty enforced by law to supplement the spontaneous agencies of society where these fail to protect the industrious and intelligent against the destructive consequences of neglect on the part of the idle and the ignorant. There are regions—some parts of my own State worst infested by the Chinch Bug, for example—where there seems really to be no choice between legal compulsion on the one

hand and the slow and enormously expensive operation of the law of natural selection on the other. Either the slow processes of social and economic revolution must be allowed to take their destructive course, carrying down too often the bright and willing farmer with the hopelessly sluggish mossbacks all around him, who breed insects by the bushel to devour his crops with their own, or we must have a State or county board, acting in conference with the official entomologist, empowered to recommend a protective procedure in cases which are clear beyond all reasonable controversy and to assign penalties for a failure to conform. I would, myself, advise both State and county boards—perhaps those agricultural boards already existing—on the ground that it is useless to attempt to enforce measures, however plainly necessary, against the common sentiment of the locality.

Next and finally, I beg to call attention to some facts growing out of the dispersal of most of us, one or two in a place, and to the territorial limitations set upon the work of those of our membership who are in State official positions. The boundaries of the States we supervise are usually artificial and not natural, especially not entomological or agricultural, from which follows the fact that several of us are interested, in very many cases, in the same problems, presenting themselves under identical or very similar conditions, and the further fact that some of these problems require for their solution a broader territorial range than we are expected to take. We are also commonly so pressed upon by a multitude of minor practical matters of special but temporary interest, that no one of us can command the time for continuous study of large general questions, either theoretical or more directly practical, which affect all of us more or less, but which remain from year to year substantially untouched.

There is in the Mississippi Valley what is known as the "chinch-bug belt," running from southern Illinois through Missouri and over the larger part of Kansas, a district where two or three dry years may always be expected to bring that arch pest of agriculture to the front. We are all at work upon it, but each for himself, without concert of plan or regular interchange of ideas and results. On the other hand, none of us are studying the general subject of the reasons, geological, agricultural, or climatic, for the existence of this well-marked belt. If I am asked why southern Illinois is thus infested while southern Indiana is relatively free, I can merely guess at a more or less probable reply.

Further, we occasionally find, when far advanced on some piece of unmitigated drudgery, some laborious and tedious compilation of the literature of a single crop, for example, that one or two others in neighboring States have long been busy with the same subject, and that much work has thus been duplicated to no good end. I lost the larger part of a year's work of one assistant in this way not long since.

Now the remedy for these and other defects which I have not time to specify is not general direction, or even supervision—we are too

intensely American to submit gracefully to that—but organization rather, and that of some loose and perfectly flexible form, which will leave each entirely free to meet the special requirements of his individual work, but will at the same time help to concentrate and coördinate the surplus effort which all, or several, may be willing to contribute to the accomplishment of common ends. For this purpose I would suggest a system of what we may call volunteer committees. Let an association committee on coöperation propose a list of subjects for which in its judgment coöperative effort is desirable. Let this list be discussed and amended, if need be, by the association at its fullest meeting, and increased or changed from time to time thereafter, and then let volunteers offer for the the various subjects, some to work singly on topics of general interest (from which others should then withhold their hands), and some to combine for purposes requiring combination. Each volunteer committee would naturally report progress to the general committee previous to our annual meetings, and the general committee would make a general report in turn to the association itself, with such recommendations as the experience of the year might indicate. As subjects were satisfactorily completed, the results would be presented to the association for publication, or published independently in the bulletins or reports of those engaged in the work, as might be desired.

I venture to think that in some such way we may obtain all the essential benefits of organization without any surrender of individual initiative, and without hampering ourselves in any respect.

But whatever may be your decision on these general matters, and whatever form the general policies of this association may finally assume, our strength is now and will always be in the ability, skill, activity, and public spirit of our individual membership, and in these particulars I need not say that we have every reason for satisfaction with the past and encouragement for the future. I congratulate you most heartily, ladies and gentlemen, on the solid and useful character of the year's work just past, and on the brilliant prospects of this, the fifth regular meeting of our association.

The address was discussed by Messrs. Osborn, Smith, and Webster. Mr. Osborn thought that laws requiring farmers to destroy insect pests appearing on their farms could be made effective, and gave the operation of the Canada thistle law in Iowa as an example. He thought that such laws should apply in all cases only to such pests for which good remedies could be recommended. The Fall Web-worm could, he thought, be easily controlled in his State if everyone was required to destroy it whenever it appeared on his place.

Mr. Smith spoke of the difficulty of inducing many farmers to take any precautions in checking the injuries of insects, and thought that laws requiring them to give attention to such matters could not be enforced. The weed law of New Jersey was mentioned as an example of the ineffective working of such laws. He was of the opinion also that

the number of laws required if one were made for each pest would be a difficulty not easily surmounted, since it was not easy to get legislators to pass such laws.

Discussing the suggestions as to combined effort on the part of official entomologists, Mr. Webster suggested that it would not in some cases be practicable for station entomologists to do any work but that required in their own States because of opposition from the directors and other authorities.

Mr. Forbes thought a community which would not enforce laws relating to farm pests must be left to suffer, but he had known instances where public opinion on these matters was such as to compel farmers to give them attention.

Reports of officers were then called for. The secretary reported that for the printing of circulars, invitations, and programs the sum of $10.55 had been expended during the year, for which an assessment of members attending the meeting would be necessary.

Mr. Webster moved that a committee of three be appointed by the chair to consider the matter of raising funds for the regular expenses of the association. Messrs. Webster, Smith, and Hopkins were appointed.

Messrs. Edward H. Thompson, of Tasmania, and R. Allan Wight, of Auckland, were proposed as foreign members of the association by the secretary.

Mr. Smith moved and Mr. Osborn seconded a motion calling for the appointment of a committee of three to consider the recommendations contained in the address of the president. Messrs. Osborn, Smith, and Garman were appointed.

A paper by Mr. Osborn was next read.

METHODS OF TREATING INSECTS AFFECTING GRASSES AND FORAGE PLANTS.

By HERBERT OSBORN, *Ames, Iowa.*

In the treatment of this subject, it is desirable to consider all the insects affecting the crops mentioned, especially with reference to the duration of life and the time spent in the several phases of existence. It will be manifestly impossible to treat in detail the individual species attacking these crops, even were it desirable on such occasion, and in order to condense the matter sufficiently and still exhibit the essential facts, I have prepared a table, giving the names of the important species in each order and showing the stage in which they are to be found in any particular season; also, part of plant attacked and duration of life cycle or annual generation.

It may be proper to state that to properly limit the paper, I have considered the term "forage plants" to cover the clovers and only such crops as are commonly used for pasture and not including such crops as corn, oats, rape, and some others that may occasionally be used in this manner. Reviewing now briefly the more important groups affecting these crops, we have in the Hymenoptera no species which need claim our particular attention, though the Wheat Joint-worm, *Isosoma hordei*, sometimes affects grasses. In the Lepidoptera we have among the species of Colias, Lycæna, and various species of Hesperiidæ numerous examples which affect clover or grass, but few of them are known to be particularly destructive. They have not received much attention from the economic standpoint. Their habits render them free from attack by any available method and in general they must be left to the attention of their natural enemies. In the family Noctuidæ we have an assemblage of species which are notably pasture-infesting forms and many of them are extremely destructive. Such species as *Agrotis bicarnea, messoria and saucia; Hadenaa devastatrix, and lignicolor; Nephelodes violans, Leucania unipuncta and albilinea* being representative forms. In nearly all the species, the damage is mainly caused during the night time and the larvæ are sheltered or concealed during the day time, either at or under the surface of the ground. From the fact that they cut off leaves and stems the damage they do is far greater than the loss of the mere portions which they eat. In the majority of these species the eggs are deposited and the larvae become partially grown during late summer and autumn, and consequently early plowing of sod land which is to be used the following season for some other crop must be recommended.

The Clover Hay-worms, *Asopia farinalis* and *costalis* affect particularly stored hay, including clover, but attention to clearing out affected haymows and stack bottoms during spring, and burning the webbed portions, including worms and pupæ, should prove effectual. In the family Pyralidæ, we have a group of insects, Crambus and allied forms, which are essentially pasture and meadow species. Species of Crambus, particularly, form silk-lined burrows just beneath the sod and come to the surface and cut off grass above the crown. The species, *Crambus vulgivagellus*[1 2] and *exsiccatus*[3] have been studied in this country, and it seems that when at work in the grass there is little opportunity to attack them. Moths, however, are strongly attracted to light and for *exsiccatus* at least, the attracted individuals are in large part females loaded with eggs; so, for this species, there can be no question as to the value of trap-lights. In changing from grass to some crops where this species is abundant, attention should be given to the life history, as by proper adjustment of time of plowing. The future crops

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[1]Lintner: First Annual Report of State Entomologist of New York, p. 187.

[2]Riley: Annual Report United States Department of Agriculture, 1881.

[3]Osborn: Report on Insects of the Season in Iowa, Ann. Rept. U. S. Dep. Ag., 1887.

may be entirely protected, while lack of such attention may expose them to serious damage.

In the Diptera, we may consider the Crane flies as having an important relation to grass crops, but they have not received sufficient attention in this country to enable us to give very satisfactory details of their life history, or to present any established method of attack upon them as pasture pests. Prof. Webster says: "Of the species studied, there is not one the ravages of which can not be almost entirely prevented in young wheat by plowing the ground during late August or early September, and there is every reason to believe that if the fall growth of clover is kept mowed or grazed off during September and October little trouble will likely follow from the depredations of the larvæ the following spring." The Clover-seed Midge and the Clover-leaf Midge, are well-known destructive forms, and in most localities where they were destructive years ago reports indicate that the parasites are now quite effectual in keeping them in check. In localities where they are still destructive the early recommendations regarding the cutting early of the first crop may be considered as useful, but there seems to be some lack of success in this method as generally applied. Some farmers prefer to pasture their clover fields during the first part of the season, on the ground that they prevent the development of the first brood, but if this is adopted, it would seem to me desirable to allow the clover to head and the midges to deposit their eggs, then the turning on of a large number of cattle would insure the destruction of the larvae. I might here call attention to a prevailing opinion that the midge may be transported in clover seed. My own observation is that the midges contained in the clover seed are totally dry and lifeless and do not revive with moisture. It is possible that if they were far enough advanced to assume the pupa stage they might be able to withstand the dryness of the stored seed, but practically this seems not to occur.

The *Meromyza americana* though recognized as a wheat pest has been observed to affect grasses, and is considered in this relation by Mr. James Fletcher.[1]

Among the Coleoptera the Elateridæ furnish us a striking example of adaptation to life in sod land, numerous species being found in grass, and while their depredations are not noticeable because of the underground attacks upon the roots of the plants, we can not doubt that they form a serious drain upon the vitality of the crop. The admirable studies of these insects at the Cornell Experiment Station detailed in Bulletin No. 33 are the most exhaustive investigations yet made of this insect. They are generally supposed to require about three years in their development, and consequently we may expect little damage from them in new pastures. They become very abundant in old sod land, and where such ground is plowed at such time as to favor the further

[1]Report of Entomologist Cent. Exp. Farm (Canada), 1889, pp. 66, 67.

development of the wire worms, the following crop will very likely be seriously affected, whereas an early plowing is said to prove a very complete destruction to the insects and protection to the subsequent crop.

The white grubs form another characteristic group of grass-feeding species, working under ground, often with remarkably destructive results. Recent studies by Forbes, Perkins, and others show that the most, if not all, mature in late summer and remain in the imago stage till spring, and it would seem, therefore, that early fall plowing should be serviceable here as with the Elateridæ. These are parasitized by a fungus described many years since by Prof. Riley, and are also attacked by a species of Isaria which has been studied particularly in France with the view of its dissemination. While there is no question as to the destructiveness of these parasitic fungi, the conditions of their spread in any given field are such as to make it doubtful whether they can be depended on for any extensive destruction of this pest. It has been proven that kerosene emulsion will destroy such larvæ, but expense will limit this method to lawns or very valuable plats.

Among the Hemiptera we have the common Chinch Bug as a grass-feeding species, and its most serious attacks are directed toward the annual grasses, but it seldom proves destructive in pastures or meadows. In the family Jassidæ we have a large number of species that are strictly grass-feeders and mostly abound in meadows and pastures, especially on land which has been for some time in grass. Their work is entirely above the surface of the ground and consists in punctures of the leaves and stems, these punctures resulting sometimes, I believe, in the so-called silver top of blue grass, and in all cases proving a drain upon the plants and, where the insects are numerous, an important loss to the crop. In the genera Deidrocephala and Deltocephalus, eggs are deposited in the leaves or stems, by the fall brood and remain over winter in this location; therefore, burning the grass, or its treatment with kerosene emulsion, is to be considered advantageous. Plowing will also doubtless dispose of a considerable number, but if done at the time when adults can pass into other fields, it can not be considered as a complete method of extermination. There are a number of species of Cercopidæ and Fulgoridæ injurious to grasses, but for most of them only a few details of their habits are known. Aphides affect quite a number of grasses, attacking the roots and stems and leaves, and are for the most part difficult to attack. Such species as migrate to trees and woody plants for winter may possibly be treated with success, when we have more fully determined their habits. Thripidæ occur very commonly in the blossoms of some grasses, and especially in clover. The extent of their damage, however, may be considered as problematic, and from our present knowledge of them there seems to be little opportunity to use any feasible method of treatment.

In the order Orthoptera we meet a large number of species among

the crickets, grasshoppers, and locusts, that are common pasture and meadow pests, feeding above ground upon the leaves and presenting but one brood each year. Most of them deposit eggs in fall, but a few in spring and early summer. Many of them can be attacked directly with good success. While such methods as harvesting, etc., are available in particular cases, it would seem to me an excellent plan to use the tar pan repeatedly along the edges of farm roads or over hard ground where the females congregate to deposit eggs late in the fall, preventing, as far as possible, the deposition of eggs. This might be followed with the ordinary method of plowing such places late in the fall. Aside from these general groups which have been mentioned, there are various species among the other orders, and also a few mites, which may be considered as meadow and pasture pests.

In the discussion of treatment we may consider (1) the natural checks and enemies of grass insects, (2) agricultural methods, and (3) direct methods of attack.

Considering now the agencies for the control of these insects we have as natural agents (1) the climatic conditions, and (2) the natural enemies. It is a matter of common observation that insects, especially such forms as chinch bugs, plant lice, leaf hoppers, etc., are affected by conditions of weather, especially being retarded by cold and wet seasons, so that their injuries at such times may fall far below what would be expected under other conditions. Such conditions of weather can not be controlled, but it is in some cases possible to adapt crops with reference to them, or in case of pasture and meadow to take account of these in the planning of pasturage or regulating the number of animals pastured on a given area. Most of these pests have their natural enemies; a mention of the *Tachinidæ* and *Ichneumonidæ*, *Acaridæ*, and of various birds, rodents, and insectivorous animals would be sufficient to indicate the sources of benefit. It may be well to emphasize, however, the importance of frogs, moles, skunks, raccoons, and so far as the pastures are concerned, the common striped squirrels as agents in the destruction of grasshoppers, cutworms, wireworms and many other of the pasture pests, and we may also expect some help through the various fungi which tend to propagate and distribute themselves.

AGRICULTURAL METHODS.

Under this head we may place such methods as cropping, and also the regulation at times of plowing and harvesting, etc., which are for the purpose of affecting certain insects. These must necessarily depend on the life histories of the insects which it is intended to attack. There is naturally the probability of the presence of a number of different kinds of insects on the same land, and frequently treatments must be planned separately for the different species. In some cases, however, a method may be adapted to affect a number of different

insects in one treatment. It is therefore desirable that the cultivator should be able to recognize insects sufficiently at least to know which are more serious at a given time and act accordingly. First among such methods we may consider that of plowing with the intention of planting the ground with a different crop.

For many of the insect pests there is no very practicable method to apply on a large scale except to plow up the land and put it in some other crop for a year or two. The habits of many of the species are such that they do not become numerous or particularly injurious in grass land until three or four years at least after planting to grass. Wire-worms, cut-worms, white grubs, bill-bugs, and also many of the Jassidæ, Cercopidæ, Fulgoridæ, and Acridiidæ increase in number from year to year until the grass is much reduced in vitality. Such grass land is commonly considered to be run out and often thought by cultivators to have exhausted the soil for grass or to have lost its vitality. In reality, I firmly believe this running out is more often due to the increase of insects, both subterranean and leaf feeding. The main point to be accomplished when a change to another crop is necessary or practicable is to arrange the transfer so as to avoid injury to the subsequent crop. Reference to our table will show that for the cutworms, wireworms, white grubs, and to some extent probably for the Hemipterous and Orthopterous insects, by far the greater protection to the following season's crop is procured by an early fall plowing—a conclusion which is supported by practical experience and may, I think, be considered thoroughly established. As to times of harvesting, we have in the case of the Clover-seed Midge, Clover-seed Caterpillar, Wheat-head Army-worm and some other species much to warrant us in the conclusion that early cutting of the crop with prompt storage will accomplish much in the destruction of these insects while still immature.

The use of fertilizers may be also considered under this head. For much of the western country any use of commercial fertilizers is hardly to be considered a practicable mode of treatment, but where the use of fertilizers upon grass land is in practice, the use of fertilizers which have insecticidal properties is no doubt an important means of contending with insect enemies. The value of such materials has been strongly urged by Prof. Smith, who cites experiments indicating the destruction of wireworms by the use of kainit.

In cases where a change is to be made to some other crop, and particularly where it is desired to continue a field in grass, trials of this substance may well be made with special reference to its insecticidal value.

DIRECT METHODS.

Direct methods of attack on grass pests will doubtless always be the most difficult to enforce. The average farmer seldom appreciates the importance of adopting such means sufficiently to use any method requiring extra labor or expense. While ready to resort to the rota-

tion of crops or other measures which often really involve a greater outlay or loss, he dislikes to adopt measures unfamiliar or involving special study which may be really effective. In general it may be said that root-infesting species are protected from direct attack in the destructive stages. While it has been shown that such larvæ may be destroyed by the use of kerosene emulsion, such applications in quantities sufficient to destroy the larvae beneath the surface of the ground would not be considered of general practicability. Many of these species however may be attacked at other stages. Noctuids and Pyralids are attracted by lights, and some of them certainly prior to egg laying, so that for certain species trap lights may be recommended. Elateridæ may be destroyed in the adult stage by the use of arsenical baits; Lachnosterna may to some extent be affected by spraying the trees with arsenical solution, and some of the root-infesting Aphids by the destruction of their spring generations on woody plants. For the species feeding upon the stems, leaves, and seeds of plants, applications must depend upon the insect and the nature of its attack. In some cases, we believe a broadcast spraying of the arsenites for leaf-feeding species and of kerosene emulsion for suctorial species might be applied with profit. For grasshoppers and leaf hoppers the use of the tar pan, a method which has proven very successful, may be recommended. This process is perhaps worthy of most extended recommendation, and there can scarcely be a doubt that its general adoption upon pasture and meadow lands would result in great profit. It is also quite certain that for many species eggs are laid in the grass in autumn, and late fall or early spring burning will prove of great advantage if conditions will permit adoption of this plan.

In the most general way, therefore, we may recommend—

(1) A general rotation of crops, especially for clover and for meadows generally, and change at the end of four or five years at the most.

(2) Where it is desirable to keep the same field continually in grass or for a long series of years, as in rough land or woodland pastures, attention to the maintenance of trap lights, the use of arsenical baits or applications, burning, and the tar pan should be practiced, especially after the second year.

(3) To allow ground squirrels, moles, and other natural enemies to carry on their work unmolested, and in case their multiplication affects surrounding crops to adopt means of protecting such crops without destroying these animals. If in localities where fertilizers may be used with profit, to adopt the use of such kinds as may have insecticidal properties.

Seasons and states of insects in

	Food plant and part of plant.	Annual broods.	December. January. February.	March.	April.
Colias philodice [1]	Leaves of clover.	2	Pupa	Pupa	Imago
Colias eurytheme	Clover leaves	2	Pupa	Pupa	Imago
Colias cæsonia	Clover	2	Pupa	Pupa	Imago
Terias lisa	Clover	2	Pupa	Pupa	Imago (?)
Debis portlandia	Wild grasses	1	Larva	Larva	Larva
Neonympha eurytris	Grass	2 (?)	Larva	Larva	Pupa, im. (?)
Neonympha canthus	Grass	1	Larva	Larva	Larva
Pamphila mystic	Grass	1	Pupa	Pupa	Pupa
Pamphila peckius	Grass	1	Pupa	Pupa	Pupa
Pamphila sassacus	Grass	1	Pupa	Pupa	Pupa
Pamphila zabulon	Grass	1	Pupa	Pupa	Pupa
Amblyscirtes vialis	Grass	1 (?)	Pupa	Pupa	Pupa (?)
Amblyscirtes samoset	Grass	1	Pupa	Pupa	Pupa
Eudamus pylades	Clover	1	Pupa	Pupa	Pupa
Spilosoma acræa [2]	Grass	1 or 2	Pupa	Pupa	Pupa
Spilosoma isabella	Clover, etc	1	Larva	Larva	Pupa
Agrotis bicarnea	Grass	1	Larva	Larva	Larva
Agrotis messoria	Grass, etc	1	Larva	Larva	Larva
Agrotis saucia	Clover	1	Imago	Imago	Eggs
Hadena devastatrix	Grass	1	Larva	Larva	Larva
Hadena lignicolor	Grass	1	Larva	Larva	Larva
Prodenia commelinæ	Clover, etc	1 (?)	Larva, pupa, imago.	Larva, pupa, imago.	Larva, pupa, imago.
Nephelodes violans	Clover, grass, etc.	1	Larva	Larva	Larva
Laphygma fuigiperda	Grass, etc	2 or more	Larva or pupa.	Pupa	Imago
Leucania albilinea	Timothy, wheat, grasses.	2	Pupa	Pupa	Pupa
Leucania unipuncta	Grasses	1 or 2	Imago or pupa.	Imago	Eggs
Drasteria erechtea ?	Clover, grass, etc.	3	Pupa	Pupa	Pupa
Drasteria crassiuscula [3]	Grass and clover.	3 (?)	Pupa	Pupa	Pupa
Asopia farinalis	Clover hay, etc.	1	Larva	Larva	Larva
Asopia costalis	Clover hay	1	Larva	Larva	Larva
Crambus exsiccatus	Blue grass and corn.	2	Larva	Larva	Larva
Crambus vulgivagellus	Grass	1	Larva	Larva	Larva
Nomophila noctuella [4]	Clover and grass.	3 (?)	Larva	Larva	Larva
Grapholitha interstinctana	Clover seed and leaves.	3	Larva	Larva	Pupa
Cecidomyia leguminicola	Clover seed.	2	Pupa	Pupa	Pupa
Cecidomyia trifolii	Clover leaves.	2 (?)	Pupa	Pupa	Pupa
Meromyza americana	Wheat and grass stems.	2	Larva	Larva	Pupa
Cryptohypnus abbreviatus	Grass		Larva, imago.	Larva, imago.	Larva, imago.
Melanotus communis	Grass	3 years (?)	Larva, imago.	Larva, imago.	Larva, imago.
Agriotes mancus	Grass, etc	1 brood in 3 years (?)	Larva, imago.	Larva, imago.	Larva, imago.
Asaphes decoloratus	Grass	1 brood in 3 years (?)			
Drasterius elegans	Grass				
Lachnosterna fusca *et al.*	Grass	1 brood in 3 years.	Larva, imago.	Larva, imago.	Larva, imago.
Sitones flavescens	Clover	1 (?)	Imago (?)	Imago (?)	Imago (?)
Sphenophorus parvulus	Grass	1	Imago	Imago	Imago
Blissus leucopterus	Hungarian grass, wheat, etc.	2	Imago	Imago	Imago
Calocoris rapidus	Clover	2	Imago	Imago	Imago
Lygus pratensis	Clover, etc	2	Imago	Imago	Imago
Diedrocephala mollipes	Grass	2	Eggs	Eggs	Eggs, larva

[1] Fernald. Butterflies of Maine, p. 31.
[2] Harris. Insects Injurious to Vegetation, p. 351.
[3] Slingerland. *Ins. Life.* Vol. v, p. 87.
[4] Felt, E. P. *Canad. Entom.* 1893. Vol. xxv, p. 129.

juring grasses and forage crops.

May.	June.	July.	August.	September.	October.	November.
Larva	Larva	Pupa	Imago	Imago, larva	Larva	Pupa.
Larva	Larva	Pupa	Imago	Imago, larva	Larva	Pupa.
Larva	Larva	Pupa	Imago	Imago, larva	Larva	Pupa.
Larva	Larva	Pupa	Imago	Larva	Larva	Pupa.
Pupa	Pupa	Imago	Larva	Larva	Larva	Larva.
Larva (?)	Larva (?)	Imago	Imago, larva	Larva	Larva	Larva.
Larva (?)	Pupa	Imago	Larva	Larva	Larva	Larva.
Pupa	Imago	Imago	Larva	Larva	Larva	Pupa.
Pupa	Imago	Imago	Larva	Larva	Larva	Pupa.
Pupa	Imago	Imago	Larva	Larva	Larva	Pupa.
Pupa	Imago	Imago (?)	Larva	Larva	Larva	Pupa.
Pupa (?)	Pupa	Imago	Larva	Larva	Larva	Pupa.
Pupa	Imago	Larva	Larva	Larva	Larva	Pupa.
Pupa	Imago	Larva	Larva	Larva	Larva	Pupa.
Pupa	Imago	Larva	Larva	Larva	Pupa	Pupa.
Pupa	Imago	Imago	Larva	Larva	Larva	Larva.
Pupa	Pupa	Imago	Imago	Imago, eggs.	Larva	Larva.
Pupa	Pupa	Imago, eggs.	Imago, eggs.	Larva	Larva	Larva.
Larva	Larva	Larva, pupa.	Imago	Imago	Imago	Imago.
Larva	Pupa, imago.	Imago	Imago, eggs.	Imago, eggs, larva.	Larva	Larva.
Pupa	Imago	Imago	Eggs	Larva	Larva	Larva.
Imago	Imago	Larva (?)	Larva	Larva	Larva	Larva.
Larva	Pupa	Pupa	Imago	Imago, eggs.	Larva	Larva.
Larva	Larva, pupa.	Imago	Larva	Larva, imago	Imago, larva	Larva or pupa.
Imago	Eggs, larva.	Larva, pupa	Imago	Larva	Larva	Pupa.
Eggs	Larva	Larva	Pupa, imago.	Imago	Imago	Imago.
Imago	Larva	Imago (?)	Larva	Imago	Larva	Pupa.
Imago	Larva	Imago	Larva	Imago	Larva	Pupa.
Larva, pupa.	Pupa	Imago	Imago	Eggs, larva (?)	Larva	Larva.
Larva, pupa.	Pupa	Imago	Imago	Eggs, larva (?)	Larva	Larva.
Larva, pupa.	Imago	Larva	Larva	Imago	Larva	Larva.
Larva	Larva	Pupæ	Imago	Larvæ	Larva	Larva.
Imago (?)	Larva (?), imago.	Larva	Imago	Imago	Larva	Larva.
Imago	Larva	Pupa, imago.	Imago, larva	Larva, imago	Larva	Larva.
Imago	Larva	Pupa	Imago, larva	Larva	Pupa	Pupa.
Imago (?)	Larva, pupa, imago	....	....	....	....	
Imago	Larva	Larva, imago	Imago, larva	Larva, imago	Larva	Larva.
Larva, imago	Larva, eggs (?)	Larva, larva	Larva, pupa	Larva, pupa	Larva, imago.	Larva, imago.
Larva, imago	Larva, eggs (?)	Larva, larvæ.	Larva, pupæ	Larva, imago.	Larva, imago.	Larva, imago.
Larva, imago.	Larva, eggs (?)	Larva, larvæ	Larva, pupa.	Larva, imago	Larva, imago.	Larva, imago.
....	....	....	....	....	....	
....	....	....	....	....	....	
Larva, imago.	Larva, imago.	Larva, larva	Larva, larva	Larva, imago.	Larva, imago.	Larva, imago.
Imago	Imago	....	....	....	....	
Imago	Imago, larva.	Larva	Pupa, imago.	Imago	Imago	Imago.
Larva	Larva	Larva, imago	Imago, larva	Larva	Larva, imago	Imago.
Larva	Larva	Imago	Imago, larva	Larva, pupa.	Imago	Imago.
Imago, larva.	Larvæ	Imago	Imago, larva	Larva, imago	Imago	Imago.
Larvæ	Imago	Imago, larva	Larvæ	Imago	Imago	Eggs.

Seasons and states of insects in

	Food plant and part of plant.	Annual broods.	December. January. February.	March.	April.
Deltocephalus inimicus	Blue grass	2 or 3 (?)	Eggs	Eggs	Eggs
Deltocephalus debilis	Blue grass	2	Eggs	Eggs	Eggs, larvæ.
Lepyronia 4-angularis	Grass	1 or 2	Eggs (?)	Eggs (?)	Larva (?)
Philænus (Ptyelus) lineatus	Grass	1 or 2	Eggs (?)	Eggs (?)	Eggs (?) or larva.
Phlœothrips nigra	Clover	2 (?)	Larva	Larva	Larva, im.(?)
Thrips tritici	Clover, etc	2 (?)			
Limothrips poaphagus	Grass				
Xiphidium fasciatum	Clover and grass.	1	Eggs	Eggs	Eggs
Melanoplus femur-rubrum	Grass, clover, etc.	1	Eggs	Eggs	Eggs
Melanoplus differentialis	Grass, clover, etc.	1	Eggs	Eggs	Eggs
Melanoplus atlanis	Grass, clover, etc.	1 or 2	Eggs	Eggs	Eggs
Melanoplus spretus	Grass, clover, etc.	1	Eggs	Eggs	Eggs, larva.
Acridium spp	Grass	1	Imago	Imago	Eggs
Dissosteira carolina	Grass	1	Eggs	Eggs	Eggs
Hippiscus spp	Grass, etc	1	Imago	Imago	Imago
Tragocephala spp	Grass, etc	1	Larva, pupa.	Larva, pupa.	Pupa, imago.

juring grasses and forage crops—Continued.

May.	June.	July.	August.	September.	October.	November.
Larvæ	Larva, imago.	Imago, larva	Larva, imago	Imago(?)	Imago	Imago, eggs (?).
Larvæ	Larvæ imago.	Imago, larva	Larva, imago	Imago, larvæ(?)	Imago larvæ(?)	Imago, eggs.
Larva	Imago	Imago	....	....	....	
Larva	Imago	Imago	....	....	....	
Imago	Imago, larva.	Larva, imago	Larva, imago	Imago, larva	Imago (?) larva.	L.
Imago	Imago	Larva, imago	Larva, imago	Imago	....	
....	....	....	....	....	....	
Egg, and larva(?).	Larva	Larva, pupa	Imago	Imago	Imago, eggs.	Eggs.
Egg, larva	Larva	Larva	Larva, imago	Imago	Imago, eggs.	Eggs.
Egg, larva	Larva	Larva	Larva, imago	Imago	Imago, eggs.	Eggs.
Eggs and larva.	Larva	Larva, imago	Larva, imago, eggs.	Imago, eggs.	Imago, eggs.	Eggs.
Larva	Larva, imago.	Larva, imago	Imago	Imago	Imago, eggs.	Eggs.
Larvæ	Larvæ	Larva, imago	Larva, imago	Imago	Imago	Imago.
Larva	Larva	Larva, imago	Larva, imago	Imago	Imago, eggs.	Eggs.
Imago and eggs.	Larvæ	Larvæ	Larvæ	Imago (?)	Imago	Imago.
Imago	Imago, eggs.	Eggs	Larva	Larva	Larva	Larva, pupa.

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In discussing this paper Mr. Hopkins stated that he had not studied the insects mentioned by Mr. Osborn as causing the failure of grass fields, but that he had observed that if land on which grass is "run out" is plowed in July and sown to grass seed by the first week in August a good crop of hay would be obtained the next July, and that the crop gradually diminishes from year to year until this treatment is repeated.

The following paper was then read:

NOTES ON METHODS OF STUDYING LIFE HISTORIES OF INJURIOUS INSECTS.

By L. O. HOWARD, *Washington, D. C.*

In the pamphlet entitled "Directions for Collecting and Preserving Insects," published by Dr. Riley as Part F, Bulletin 39, of the National Museum, the chapter on "The Rearing of Insects," occupying pages 112 to 120, comprises in general and in condensed form the results of the experience of the office with which I am connected. Excellent remarks will be found under the heads of "General Directions," "The Breeding Cage or Vivarium," and "Detailed Instructions for Rearing," together with some consideration of the root cage, special apparatus, and the insectary. Under the head of "Detailed Instructions for Rearing," the greatest attention is paid to the best methods of studying the life histories of Lepidoptera, but the subjects of out-door observations of insects possessing alternate food plants, such as the Aphi-

didæ, and of insects susceptible to confinement, such as the Tenthridinidæ, are considered but briefly, and there are a few other points not treated in detail, for lack of time or space. It will be proper then for me to present, not a full discussion of methods, but certain notes on methods supplementary to the bulletin mentioned. My own personal experience in the rearing of insects has been slight, and the facts which I shall give are derived solely from observation of the methods in use in the Division of Entomology, where they have been introduced by Prof. Riley, and where they are being carried on by his able and conscientious assistant in charge of the insectary, Mr. Theo. Pergande.

There is probably no group of insects more difficult to study than the Aphididæ. Susceptible to changes of temperature and to excess or lack of moisture, attacked by a host of natural enemies, and possessing generally alternate food plants, they are apt to foil the best meant endeavors to observe their life round. Dr. Riley has, however, mainly with the coöperation of Mr. Pergande, been able to fill out the numerous gaps in the life histories of many species and to record in full those of others new to biological literature. This has only been done by the patient labor of years and by the exercise of foresight and ingenuity to a most marked degree. Take the case of the Hop Plant-louse (*Phorodon humuli*), for example. The starting point in this study was the suspected, though not perfectly proved, identity of the form on Prunus and the form on Humulus. Nearly all of the observations were made in the field and very much in the following manner: During the winter, winter eggs supposed though not known to be those of this species were marked by the hundred upon plum trees. With the bursting of the buds in the spring the marked eggs were examined. Hardly one out of a hundred was found to hatch, the others having been destroyed by predaceous insects or killed by the action of the weather. A number of stem-mothers were followed to their settling point; the leaf was marked, but at first was not inclosed in netting, as it was feared that this might interfere to some slight extent with the proper growth of the foliage. Each morning the offspring of each stem-mother were counted and were carefully removed with a camel's hair brush and placed upon adjoining leaves which were given characteristic markings. Thus the total number of offspring was ascertained and a supply of definitely known individuals of the second generation was provided for. In the same way the individuals of this second generation were followed, and as they began to give birth to their living young each one was visited every morning and the offspring of the previous day and night were removed, a sufficient number being stationed upon marked leaves to carry the investigation forward, while the rest were destroyed. At this stage of the investigation it became necessary to inclose individual leaves with netting in order to prevent the presence not only of predaceous insects but of other individuals of the plant lice which would prove disturbing elements and would be liable to confuse the investi-

gator. An accurate count of every individual within each net bag was kept and, as a matter of course, before the transplanting could take place every square millimeter of leaf surface which was to be inclosed was gone over with a lens to make sure of the nonpresence of other individuals. This course was followed with the succeeding generation, and on the appearance of the winged generation the Plum was by no means abandoned. Winged individuals were confined for days upon this plant to see whether they would deposit young upon its leaves and to see whether these young would fix themselves and procreate.

The simultaneous appearance of winged individuals absolutely indistinguishable from those upon Plum upon the Hop and the failure of the confined offspring of plum migrants to settle in a normal manner obviated the necessity for a direct observation upon the actual passage through the air of winged individuals from Plum to Hop, although, as a matter of fact, the return migration was readily observed from the greater number of individuals. Taking up the same course of observations upon the Hop, individual leaves were carefully cleaned under the lens, marked and stocked, and inclosed with netting. Every morning the young were counted and removed, some destroyed and some established upon cleaned leaves, and so the insect was followed day after day throughout the entire summer, the exact number of generations found, the exact intervals of the winged generations, the exact point at which the sexual individuals appeared, the exact number of offspring of a considerable number of females of each individual ascertained, and the return flight to Plum observed.

Here the return migrant females were carefully watched in the same manner as before until they gave birth to the true sexual females, the number of molts was counted, the number of offspring ascertained, and the latter were isolated, and watched almost every minute to full growth. In the meantime the development of the male, which is winged, was also watched on Hop in similarly isolated individuals. Its migration to Hop was in turn followed and a certain number were introduced into the receptacle containing the isolated females. Thus the birth of the oviparous females was observed, the latter were isolated, and egg-laying watched.

These observations were necessarily carried out in a single locality and almost entirely by Mr. Pergande. Independent and fully corroborative observations were also conducted by Mr. W. B. Alwood simultaneously with his remedial work. I myself examined the progress of the work during a field visit and Dr. Riley took the field on several occasions to satisfy himself of the satisfactory progress of the investigation. So far for a single locality (Richfield Springs, N. Y.). The bulk of the work was done there. But it was necessary with so widespread a species to study its life-history at other points. Prof. Riley was able to do this personally in the hop fields of England and the south of France. Prof. Osborn was sent to the hop-growing regions of

Wisconsin, and, since the advent of the species upon the Pacific Coast, its life-round has been followed by Mr. Kœbele in the hop-yards of Oregon and Washington.

It will be seen from this account that the labor involved in a series of observations of this kind, which resulted in the satisfactory ascertaining of the life-history of but a single species, is something enormous, and at the same time I believe that no fault can be found with the methods used.

Where from lack of time, or from other reasons, out-of-door work upon plant lice is impossible, good results may be obtained in the insectary, provided an abundant supply of the leaves of the food-plant is available. For instance, the present summer Dr. Riley is having a study made of the life-history of a species commonly found upon the tulip tree. The summer generations are being followed up in this way: To each female under observation a glass tube 4 inches long by 1 inch in diameter is devoted. Every day a large freshly plucked leaf is cut with the shears into a square of about 3 inches each way. It is carefully cleaned with the brush on both sides, folded into a cylinder and thrust into the tube. The Aphidid is carefully removed from the old leaf by means of a camel's hair brush and placed within the cylindrical fold of the fresh leaf. A stopper of cotton is then thrust in and the tubes as soon as prepared are placed in a jar and removed to the basement, where they are kept at a constant temperature until the following day, when the process is repeated. Extremes of temperature are fatal to the plant lice, and I well remember one hot July day in 1888 when probably 999 out of every 1,000 plant lice on the shade trees in Washington were destroyed by the heat. This operation of removal can not be done too carefully, else the beak will be broken off. The change of food every twenty-four hours is absolutely essential, otherwise the drying of the leaf holds the beak so that it is impossible to remove the insect. By this method the number of young deposited each day and the number of molts undergone by each individual may be counted quite as readily and in fact a little more so than in the bags on the plants.

The study of Coccidae in the insectary is a simple one to the trained observer when the food plant can be grown and the insects colonized upon it; otherwise it becomes an impossibility, since, after the first molt, these insects can not safely be removed from their food. Most of the species remain stationary or nearly so, and their location can easily be recorded, the exact situation of each individual under observation being circumscribed by a ring of ink marked with a pen upon the leaf. The rate of travel of those individuals of species which do move slowly up to the adult stage may be determined in the same way.

All earth used in the insectary should be sterilized and sifted. This is necessary in order to destroy disease germs, in order to subsequently regulate the amount of moisture, and in order to destroy predaceous mites and also other insects which might be causes of danger or of con-

fusion. We prepare earth readily and in bulk in a galvanized iron oven $2\frac{1}{2}$ by $1\frac{1}{2}$ by 1 foot. The cover is roof-shaped and lifts off by a central handle. There is a circular orifice in this cover to emit steam and consequently to facilitate drying. The oven stands on legs $1\frac{1}{2}$ feet high (the height being simply for convenience in handling) and it is heated by a single gas jet from a Bunsen burner placed upon a support beneath. After, say, two hours, heating the moisture becomes dissipated, the earth becomes dry and is readily sifted. It is then passed through two sieves, the larger one being 6 to the inch and the smaller one 18 to the inch. It is then in proper condition to use either in large boxes for underground insects or in the ordinary breeding jars or cages.

The mention of underground insects reminds me that we have found the Comstock root cage a very excellent apparatus in theory but a difficult one to use in practice. The insects can not be observed, even when close to the glass side, to any advantage, since, with the slightest moisture, the earth becomes firmly packed against the glass, forming a layer which can not be penetrated by the eye. We have, therefore, found it more simple to rear subterranean forms in wooden boxes 2 by 2 feet by 8 or 9 inches deep, the bottoms perforated with a few auger holes covered with wire netting and containing a good supply of grass or other food plant growing. These boxes are also made of smaller dimensions and, with a good supply prepared, the earth is removed at intervals from some and the condition of the contained insects observed. It is worthy of remark that with grass-root-feeding scarabs, such as Allorhina and Lachnosterna the grass crop must be kept healthy, or as soon as it dies, they must be transferred to fresh boxes with vigorous plants.

These same boxes make excellent rearing cages for certain insects attacking field crops. Four supports in the shape of laths are nailed to the four corners of the box and a tarletan or other gauze covering is constructed to fit over in such a way as to be fastened at the sides of the box. The flap is left for the introduction of insects, and after the adults have oviposited and died the cover may be removed and the work of the immature stages observed at leisure. This arrangement, and the Riley breeding cage which has so often been figured and described, are the larger vivaria. Great use is made, however, of glass vessels of every size, from the small test tube, one-fourth of an inch in diameter by two inches long, to the large glass cylinder 18 inches high by a foot in diameter. One of these glass cylinders placed upon the slate table of the insectary, partly filled with sterilized earth and covered with a cloth held in place by a string or rubber band, makes an excellent breeding cage for certain insects. Battery jars, Mason's fruit jars, jelly jars, quinine and morphine bottles and collecting tubes, all find their proper use.

Another important rearing apparatus is the aquarium. Many styles of aquaria have been described and are on the market. Certain special

features adapting it for insect rearing, however, have been introduced by Mr. Pergande, and the result in our own case is very satisfactory. Two glass aquaria each $2\frac{1}{2}$ by $1\frac{1}{2}$ by $1\frac{1}{2}$ are placed end to end, the one elevated on a three-inch base so as to make it that much higher than the other. The water connections from the one to the other are so arranged that each may be independent of the other, and the details are simply arranged. In each a V-shaped inclined glass septum with a broad deflexed lip, and beneath this lip has been constructed an artificial rock-work grotto. The water enters the first aquarium through a T sprinkler with six pipette orifices. It drops a distance of 6 or 8 inches into the V-shaped septum and its force is easily graduated by stop cocks. Rising to the height of the deflexed lip it pours in a broad cascade into the main compartment, impinging on the top of the rock-work grotto. The second or lower aquarium is at present similarly arranged, and derives its supply of water either from the overflow of the first or independently from an overhead pipe, so that its water may be kept either still or running at will. Thus we have arrangements in a small space for the rearing of all kinds of aquatic insects. The sliding stream upon the artificial rock-work is particularly adapted for such forms as Simulium, and opportunity is also offered for such species as have the habit of crawling out either on rocks or earth, as the case may be.

One of the difficulties encountered in the rearing of insects is the proper maintenance of the right degree of moisture. Galls of all kinds, whether cynipid, cecidomyiid, or trypetid, are apt to be left either too dry, in which case the issuing of the adult is delayed far beyond the normal time, or too moist, in which case they become covered with mildew and spoil. If the jar containing them be left open they dry, no matter if sprinkled frequently. If the jar, on the contrary, be stoppered, mildew soon puts in an appearance. This difficulty is obviated by keeping all galls in a series of jars at the same height, the mouths of the jars being covered with gauze to prevent the escape of the adults or of parasites. Over the whole series is laid a large sheet of blotting paper. The blotting paper is moistened daily, and gall in insects seems to thrive under this treatment. Mildew seldom appears, and the insects emerge on time. This same plan is a good one for certain tineids.

The subject of moisture in the rearing of lepidopterous larvæ has been frequently considered, and it is a tolerably well-known fact that it is disastrous to feed these larvæ wet foliage. Spraying the leaves upon which they are at work has been practiced, but both practices result in a diarrhœic disease which carries off whole colonies, just as the same course is followed by the same trouble with the domestic silkworm. As a matter of fact, lepidopterous larvæ do not feed during a rain or upon wet foliage out of doors, as many observers will testify.

For such larvæ as feed upon growing foliage, it is absolutely essential to change the food every twenty-four hours, since while they will feed, in the absence of fresh food, upon drying leaves, this results in constipation and probable consequent febrile symptoms. At the time of renewing the food it is essential to carefully wipe out the jars or the cages.

Clean, sterilized, and sifted sand is perhaps the best substance to use in the bottom of breeding cages and for most larvæ which hibernate underground to enter for pupation. After such insects have gone down it should be kept reasonably moist by occasional sprinkling, and a free current of air should be admitted to the surface.

Of all larvæ none are more difficult to rear than those of Tenthredinidæ. Their mouth-parts seem to dry unless constantly lubricated by the saliva induced by mastication, and once dried the larva usually dies. So when received by mail from a distance it is usually impossible to rear them. They wander restlessly over the food, leave it, crawl about and die. Even when transferred, with their food, directly to the breeding cage they are usually dissatisfied and restless. Fresh food must constantly be supplied, and if possible they must not be allowed to descend to the surface of the sand, or the latter must carefully be covered with paper or blotting paper; for if they once close their prolegs on a grain of sand, they hold it convulsively and it is almost impossible to dislodge it, so that they are practically unfitted for again clasping a twig.

Acridiidæ are most difficult insects to rear. Confined in a breeding cage of the ordinary dimensions, they feed little and are apt to fatally exhaust themselves in futile efforts to escape. Therefore they should be inclosed in a large gauze-covered inclosure, say 3 feet square, and in the earth should be growing not only grass but also weeds of various sorts, such as Astragalus, Amaranthus, and Rumex. Their close allies the Locustidæ are, on the contrary, very easy to rear in confinement and need only be given an occasional supply of fresh food to flourish even in close quarters. So also with the Phasmatidæ and Mantidæ. The latter require no moisture whatever, beyond that which they get from the bodies of their victims.

In rearing hymenopterous parasites the jar should be tightly closed and an occasional narrow strip of moistened blotting paper inserted. Or they may be inclosed in glass tubes with tight absorbent cotton stoppers, the stoppers being occasionally moistened. Bees, such as Megachile, need very little moisture and give little trouble in rearing. Stalk-borers of all kinds may, as a rule, be kept perfectly dry or only moistened somewhat every two or three weeks. Plant-feeding Heteroptera need simply plenty of fresh food and will take care of themselves, with comparative indifference as to their surroundings. Certain other coleopterous larvæ, such as most of those of the adephagous series, should be

kept in large glass jars with no cover whatever, as they seem to require plenty of fresh air.

All of these indoors and rearing-cage notes, however, concern things which will gradually be learned by experience, and after all, with the majority of insects, nothing can take the place of outdoor work. I have given with so much detail in the early part of this paper the methods used in the investigation of *Phorodon humuli*, mainly to emphasize this point. More particularly the case with Aphididæ and Cynipidae, since these forms exhibit an alternation of food plant or an alternation of generation, the rule holds in only slightly lesser degree with all forms of insect life. To gain the clearest and most accurate idea of a life history the insect must be studied under perfectly natural conditions, and not under conditions which more or less imperfectly simulate the natural ones. There is no easy road to the most perfect knowledge of habits. It involves tramping through mud and bramble patches; it involves the constant risk of sunstroke, and in our Southern country the constant presence of Leptus and Ixodes; it involves constant watching and watching and watching, astride the small limb of a fruit tree, perhaps, on your back under bushes, on your knees in the wheat field, on your stomach in the pasture, with your face down close to a cow's dropping, and with the summer sun beating down upon your unprotected head, watching and watching until your eyes grow dim; but in this way only are the unsolved problems in the life histories of injurious insects most satisfactorily worked out.

Mr. Forbes wished to know how close Mr. Howard found it possible to keep the temperature of the insectary to the out-of-door temperature, and suggested the electric blower as a means of ventilation. Mr. Howard thought that by proper contrivances for admitting air the temperature might be kept practically the same as that outside.

Mr. Forbes thought that work on the life histories of insects carried on indoors should be verified constantly by observations on the same insects in their natural haunts.

Mr. Garman suggested that some insects were much more influenced by being kept indoors than others, and stated that he has sometimes been surprised to find that insects kept in a dry and heated room went through their stages at the same times as those out-of-doors.

The following paper was then read:

ANOTHER MOSQUITO EXPERIMENT.

By L. O. Howard, *Washington, D. C.*

Just as "one swallow does not make a summer," one experiment does not fully satisfy the economic entomologist of the value of a remedy. At the last meeting of this association I laid before you the facts concerning an experiment in applying kerosene oil to the surface of a mosquito breeding-pool and argued from its results that in many localities where the breeding places are circumscribed the mosquito plague may be largely averted.

The publication of this paper excited considerable interest in the subject and brought me some little correspondence from individuals who considered themselves advantageously located for the testing of the remedy on a larger scale than I had been able to attempt. Dr. Wooster Beach, of New York City, wrote last fall that it appeared to him quite possible to treat large tracts of land in the manner proposed, and solicited Government aid in locating breeding places in Westchester County along Long Island Sound, provided he could interest property holders and raise a small fund to be expended in the purchase of kerosene and the wages of men to apply it under expert supervision. The necessary aid was promised him, with Dr. Riley's sanction, and he made a strong effort to arouse the popular interest by articles in the local papers; but either through nonsusceptibility to mosquito poison on the part of his neighbors, or through indifference arising from other causes, he failed to collect the fund, and an interesting experiment on a large scale was thwarted.

Another very satisfactory experiment upon a small scale, however, has been made the present season. But before recounting the facts in the case I must advert to the chronic disinclination on the part of the property holders of a given neighborhood to admit that they are troubled by mosquitoes. I spoke in Insect Life last fall of a New Jersey mosquito remedy, recounting the killing by its means of seventy-five mosquitoes on the ceiling of my room in a New Jersey town, the name of which I thoughtlessly published. By the next mail after the issue had reached that part of the country I received letters from two residents of the town warning me that I would be mobbed by the inhabitants if I ever set foot in the place again, that is, provided my note should happen to be republished in some more widely read journal than Insect Life. New Jersey and mosquitoes had been coupled in my mind since earliest boyhood, and I was totally unprepared to learn that our cultivated and refined neighbors were sensitive on the point.

However, after this experience I was not surprised to find that the gentleman who conducted the experiment which I am about to detail desired his name, and particularly his locality, to be kept from the public eye. I may state, however, that it is within two hours' ride

from the city of Washington, and that I have had an opportunity to verify the condition of affairs as reported to me.

The gentleman in question had seen in one of the newspapers some account of my Catskill Mountain experiments and wrote me through a mutual friend in Washington for detailed advice in his own case. Correspondence elicited the fact that the mosquito supply must come from a small mill pond one-eighth of a mile from his house, from a small, marshy tract above the pond, and from two horse troughs, one at his barn and the other at the roadside in front of his house. He had also a large rain-water barrel for which he immediately had a cover constructed at my advice.

The horse troughs were readily freed from "wrigglers" by using a small fine-meshed hand net every few days, and the kerosene treatment was used for the mill pond and the marsh. Estimating the surface area of the pond at 4,000 square feet, he sprinkled on 15 gallons of the cheapest kerosene. This formed a continuous layer, and remained evident to the senses, in the absence of rain, for two weeks. Three weeks after the application, which was made on the 4th of June, I visited the place and found that the kerosene was still operative, although a slight shower had fallen on the seventeenth day. No trace of a living aquatic larva of any kind could be found, and the surface of the pond was thickly strewn with dead aerial insects, among them many female mosquitoes.

A few straggling living mosquitoes were noticed about the house the first week in June, but none subsequently, and although the treatment was not repeated none have been reported to have appeared during July.

The small marsh pools above the dam were treated at the same time, 2 gallons of kerosene being used for this purpose. The ensuing drought, however, dried these pools up thoroughly and vitiated the experiment. The total expense of the treatment was $1.70 plus two hours light labor for two men, and the result was immunity from mosquitoes for the household and vicinity.

This is a typical case of those which I had in mind when I expressed last year the opinion that there must be many localities where, by the use of these simple remedies, the mosquito plague may be averted.

It may be well to add that I had the pleasure of receiving, in May last, a note from Dr. Robert H. Lamborn, the donor of the mosquito-essay prizes of two years ago, in which he says, "Your exact observation regarding the treatment of insect-breeding waters with petroleum is most useful and it seems to me to be new." I trust it is understood that no novelty is claimed for the idea, but that I have simply recorded these experiences as showing conclusively that the remedy is not a theoretical but a practical one.

Mr. Smith had known of two recent cases of the use of coal oil for destroying mosquitoes on Long Island, and stated that the results supported Mr. Howard's claims for the method.

Mr. Webster thought that the matter needed more experiment; that there was a prevalent opinion that mosquito larvæ in ponds appropriated a good deal of organic matter that would otherwise become offensive, and by destroying them it was possible to do harm instead of good.

The following paper was next read:

PHYTOMYZA AFFINIS FALL., AS A CAUSE OF DECAY IN CLEMATIS.

By Dr. J. Ritzema Bos, *Wageningen* (*Netherlands*).

[Read, in the author's absence, by H. Garman.]

For a few years a disease, formerly unknown, has been observed in various kinds of cultivated Clematis in the gardens of horticulturists in the Netherlands, especially at Boskoop. The affected plants have a diseased spot above the level of the ground; the lower parts are left in perfect health; this can be said in particular of the roots. The parts of the stem lying higher than the diseased spot remain uninjured at first; they dry up, however, because they can not get a sufficient quantity of sap. On the affected spot all parts have become brown and have died; in the first place the cells around certain very narrow mines, in the tissue of the stem. Especially the fasciculi vasorum have become brown in a high degree from the sick spot upward to some height. The sick spot is always recognizable on the outside. In the dead tissues I found, almost as a rule, a fungus of the genus *Pleospora* or a cognate one, and further a few kinds of Anguillulids. The parts of the stem above the affected spot dry up. Some systems of branches consequently die off in a very short time, while others keep in good health.

In one summer the sickness spread rapidly, so as to cause in a short time the decay of the superterrene parts of many plants, while under the affected spots new buds were shooting forth. The damage caused by this sickness was considerable. Above other varieties *Clematis jackmani* was strongly affected. At various times samples of sick Clematis stems were sent me, but I was not successful in my endeavors to make out the nature of the disease. In the "Zeitschrift fur Pflanzenkrankheiten" of Prof. Sorauer I found mentioned a similar sickness in Clematis stems; and the author of that treatise, Dr. H. Kletahn, at Bremen, gives as his opinion that the illness must be ascribed to the invasion of Anguillulids. He sent me sick Clematis stems for the purpose of a minuter examination of the Anguillulids; but I found not one representative of the genera *Tylenchus*, *Aphelenchus*, or *Heterodera*, known to live generally as parasites in plants; all the Anguillulids I discovered belonged to genera without a spear, and these kinds are indeed sometimes found in decaying tissues, but commonly do not live parasitically in plants.

A remarkable point is the sudden progress of the disease. First the tip of the stem is seen hanging slack, and two or three days after the whole stem above the said sick spot is dead. In 1891, when I repeatedly received sendings of sick Clematis stems. I did not succeed in discovering the cause of the evil, though I could not help supposing that I had to do with the mining of a very small larva. for I discovered in the affected spots mines, which I could hardly consider to be the effect of the work of the nematoid worms I had found; but I did not discover the likeness of a larva or nympha.

In 1892 I was more successful. That year the stems were sent me in June. I then found on the affected spot, in the midst of the stem, a very small larva of a fly; in some already a brownish nympha with a thin, very perishable film. About the middle of June out of these nymphæ came the little fly *Phytomyza affinis* Fall., which consequently must be considered to be the cause of the disease. All the above-mentioned symptoms of sickness, which, at first sight, seemed rather enigmatical, were most satisfactorily explained. I further found that of *Phytomyza affinis* two generations at least are born every year. Therefore, as soon as the disease makes its appearance (in early summer), all decaying stalks must be cut off and burned, lest the evil grow worse by the birth of a new generation.

Mr. Hopkins reported having observed a disease of potatoes due to mines somewhat like those described in this paper.

Mr. Garman spoke of minute mines in the terminal twigs of apple trees, accompanying a sudden blighting of the twigs, which he thought might be due to some related insect.

The following paper was then read:

FARM PRACTICE AND FERTILIZERS AS INSECTICIDES.

By John B. Smith, Sc.D., *New Brunswick, N. J.*

It is safe, I think, to assume that every economic entomologist has been at times woefully disappointed at the outcome of what seemed the most promising experiments. Most of us have learned by sad experience that because a poison, or one used as such, acts well in one instance we can not be at all certain that it will act equally well in another. Many of us have run across insects that seem to eat all our usual insecticides with perfect impunity, or upon whom they act so slowly that they are practically of no effect. I have in mind at present, from my own experience, the Rose chafer, *Macrodactylus subspinosus*, of which many farmers claim, from experiment, that the arsenites do not injure it. I am not quite ready to agree to this, but I am certain that they act so slowly as to be useless.

Frequently we find insects whose life habits are such that we can not

reach them with insecticides, even if we have such as would readily kill them. Of such a nature is the "Boll" or "Corn worm," the larva of *Heliothis armiger*, which in tomatoes lives in the fruit, and in corn lives in the ear; in both cases safe from any application we can make. We have next a series of forms which in their injurious stage live in the soil itself and feed upon the roots of our crops. In cases such as I have mentioned our battery of poison is of little or no avail, because there is no proper opportunity to make use of it. We must adopt other tactics and, if possible, use preventive measures. These may be either positive, as where we cover a tree trunk with a substance mechanically protecting it from injury; or they may be more indirect, as when we change a crop, or plant late, or early, to avoid the period at which injury is done. This latter means of prevention is one which, in my opinion, is worthy of the closest attention and consideration on the part of entomologists. Not the mere planting early or late, but the question of so arranging farm practice as to avoid insect injury to the important crop. Insects have a life history which in the vast majority of cases is practically invariable. There is, usually, a fairly well-marked date of appearance, a tolerably defined period of adult life, and a normal period of development. The first and most important problem to be solved is the exact life history of the injurious species. That done before the matter of insecticides is to be considered at all, the question should be: Can we avoid trouble or injury by modifying our practice without impairing quantity, quality, or price of crop? In many more cases than is usually believed a mere change of time will avoid injury. I do not claim any originality in this suggestion, and need only instance the fact that by a proper attention to the date of sowing, damage from the Hessian fly may be avoided. Rotation of crops, if intelligently practiced, will frequently prevent trouble when insecticides are out of the question. Our fellow-member, Mr. Webster, applied this principle in dealing with the *Diabrotica longicornis*, easily controlling what threatened at one time to become a very serious pest. Trap crops, planted principally to save the more important staple, are often available. For instance a full crop of late squashes may be obtained, free from the borer, *Melittia ceto*, if summer squashes are first planted and the Hubbards and Marrowfats somewhat delayed. The summer squashes will attract the vastly greatest percentage of moths to oviposition, and these may be removed after getting an early crop, filled with the larvæ that would otherwise have attacked the later vines. The proposition to use corn as a trap crop to prevent injury from the Boll worm to cotton has been forcibly urged by Mr. Mally in a recent bulletin from Dr. Riley's office. Methods of cultivation are frequently of use—as for instances in squashes again, where borers attack the vines near the roots. In fertile soil the joints may be covered at intervals and roots will be formed at every such joint sufficient to mature the fruit, even if entirely cut off from the original base of supplies. I have mentioned only a few instances

to illustrate the suggestions made, and make no claim to originality so far as the principles involved are concerned. All have been applied by no means as often as they might have been, but more often by far than the cases cited by me. The importance of fall plowing to destroy forms hibernating in the soil is not even suspected by many of our farmers, but need not be dwelt upon here.

In one other way much may be done to check many forms of destructive insect life—the scientific application of chemical manures, or fertilizers.

In the older States the natural fertility of the soil has long been exhausted, and it is necessary to supply the necessary plant food in some form. The traditional fertilizer is barnyard manure, and to this a very large proportion of the farmers cling as the only true material. Scientific experiments and investigations have shown that the necessary elements of plant food can be as well or better furnished in the shape of inorganic substances, and that they possess in many directions points of superiority over the traditional barnyard manure. In New Jersey the use of these chemical or "artificial" fertilizers or manures is annually increasing, and many of our best truckers, those that actually make farming pay, use nothing else. Merely as an instance of the result it may be recorded that the finest strawberries shown in Chicago this year were from New Jersey and were grown with chemical fertilizers only.

It occurred to me, some years ago, when I noted that farms where these chemicals were used were unusually free from insects, that they might have insecticide properties that could be very usefully employed. Peach orchards were then suffering quite severely from the *Aphis persicæ-niger*, which sapped the roots, especially of small and nursery trees, and my first experiments were directed to the question of the effect of kainit and muriate of potash on plant lice. I found them sufficiently effective to risk recommending them for use, particularly the kainit. Since that time almost every large grower of peaches in the State has dosed his infested trees with kainit, and I have not yet found an instance of failure where it was intelligently applied. How far stupidity can go is shown by a grower who carefully piled little hills of this material round his nursery trees, to make certain it should all get to the roots. He lost almost every one of his trees, though the application, if broadcasted, would have been considered a moderate one only. Of course the potash acted as a stimulant and supplied needed plant food; but even though part of the improvement was explainable in this way in some cases, yet it really made very little difference so long as the primary object, the destruction of the Aphids, is concerned.

In some sections of New Jersey the Corn Web-worm has become somewhat troublesome of late years, and in this season of 1893 is worse than ever before. I have inquired and examined carefully in a number of

cases, and in every case I found that where chemical manures were used injury was insignificant or entirely wanting, while in many other fields in which old methods were employed no stand was obtained after two or even three replantings, and the fields looked excessively ragged and uneven. In one of the bulletins of the Delaware Experiment Station this fact is quite evidently brought out, though not aimed at in the experiment made. Muriate of potash is less effective than kainit, but has very decided insecticide value. Nitrate of soda ranks close to kainit in effectiveness, and is peculiarly valuable as a fertilizer from the rapidity with which it becomes available as plant food, strengthening and stimulating growth as well as destroying insects. I have had opportunities several times this year to note wire-worm injury on farms treated by chemical fertilizers as compared with those on which the usual routine was followed, and the verdict was always and vastly in favor of the chemical manures. No insects can live for any lengthy time in a soil saturated with these fertilizers, and I have tried all forms that have come under my notice. Mr. Fletcher found white hellebore very effective against the cabbage maggot; tried on a maggot that is found in diseased onions, hellebore was far inferior in its action to kainit or nitrate of potash. Truckers using these materials constantly are a unit in claiming practical exemption from cut-worm injury, which is often very severe on planted crops.

I have no desire to present statistics on this subject; these I will reserve for another occasion; my object will be gained by the few citations that have been made and which are examples of those upon which I base my faith that the intelligent use of fertilizers will be of very great aid in eventually freeing us from the injuries of many troublesome species.

This, combined with other intelligent farm practice will, I think, prove the main reliance of the farmer in future. Insecticides will and must continue to be used in some cases; but in my opinion they have been sometimes relied upon to the exclusion of more radical measures.

The strength at which a substance proves effective, and its action on the plant, are matters of importance. Two hundred pounds of nitrate of soda and 600 pounds of kainit are not unusually large applications, and calculating this amount to onion rows I found that to make a thorough application I must use the nitrate at the rate of $5\frac{1}{3}$ ounces to 1 gallon of water, and kainit 1 pound to 1 gallon. I made certain that these were effective insecticide mixtures, and then had one of our leading onion-growers try them over onion rows. They did not injure the plants in the least, either as to leaf or bulb, and as 10-foot rows were treated, injury would have been quickly noticed. Even the tender foliage of rose will stand a solution of kainit at the rate of 8 ounces in 1 gallon.

As a matter of fact the solutions which come into contact with the

insects are often saturated, and much stronger than the mixture given, for if the material is broadcasted or sown in the rows, each drop of water carries with it all that it can dissolve, and as the moisture evaporates the mixture becomes just as strong as it is possible to be, and of course the insecticide effect is intensified.

I will close by simply referring to the fact that the phospates have no insecticide value so far as my experience has gone—not even the odorless phosphate, which has been put upon the market with the usual nostrum circular claiming that it would kill everything.

This paper was discussed by Messrs. Hopkins and Webster.

Mr. Hopkins thought it was a question as to whether the fertilizers really kill insects, or by giving plants increased vigor enable them to outgrow injuries. He had observed in his practice on the farm that the use of stable manure on sod infested with white grubs and wireworms had the effect of producing a good crop of corn when plowed under, while on adjoining land not fertilized the attack of these insects was very destructive.

Mr. Webster had no doubt that fertilizers increased the vigor of plants but thought that Mr. Smith had not demonstrated that they destroyed or drove away the insects.

On motion the association adjourned to meet at 9 o'clock, a. m., August 15.

SECOND SESSION—AUGUST 15, 1893.

The association met in room 24, Science Hall, at 9 o'clock, a. m., President Forbes in the chair.

Mr. Webster moved that Messrs. Edw. H. Thompson, of Tasmania, and R. Allen Wight, of Auckland, New Zealand, be elected foreign members of the association. It was carried.

The secretary stated that he had received in reply to invitations sent to foreign entomologists letters of regret for inability to attend our meeting from the following: H. du Buysson, of France; F. A. Marshall, Cornwall, England; Dr. J. Ritzema Bos, Wageningen, Netherlands; Dr. H. Hollrung, Halle, Germany; Edw. H. Thompson, of Tasmania; R. Allen Wight, Auckland, New Zealand; Dr. C. C. Vinton, of Korea, Asia; Natalis Rondot, Lyons, France; Robert Newstead, Chester, England; Miss Eleanor A. Ormerod, St. Albans, England.

An extract from Miss Ormerod's letter was read containing complimentary words concerning the work of the association and its members.

The following paper was then read:

THE PRESERVATION OF LARVÆ FOR STUDY.

By H. Garman, *Lexington, Ky.*

It is a common practice to drop larvæ of all sorts into alcohol and trust to luck for what happens. My own specimens have been largely preserved in this manner. Frequently they become badly discolored and shrunken, and the internal organs are generally in very bad condition for dissection. Some practice in preparing larvæ for sectioning some years ago led me to adopt the method of killing, and at the same time fixing the tissues of such specimens by a short exposure to hot water. Recently I have employed this for the preservation of larvæ for specimens, and with what seem to me fair results. The procedure employed after a few experiments is this:

Drop the larvæ into water heated to the boiling point (not boiling) and leave for 15 seconds; then when the body wall is somewhat rigid, pick up with the forceps and with fine sharp scissors cut a slit along the under side of the body, then drop into the water again for a few seconds longer. The specimen may now be transferred to 50 per cent alcohol, and in twelve hours to 70 per cent, and twelve hours after to 95 per cent for permanent preservation.

The bodies of such larvæ remain in their natural shape. The colors are pretty well preserved, and the structures are in good condition for either microscopic or macroscopic examination. I find that it will not do to cut slits at intervals along the under side of such larvæ, for the regions between cuts then become discolored. This trouble becomes worse in hot weather.

Everything must be done quickly but thoroughly. Prolonged heating will cause specimens to become discolored by cooking them. Instead of alcohol I have used for some specimens, after killing with hot water, a preservative which gives, as far as I can see now, rather better results. It consists of the following:

Boiling water, 250 cubic centimeters.
Common salt, 3 teaspoonfuls.
Powdered alum, 1 teaspoonful.
Pure carbolic acid, 5 drops. *Filter.*

The paper was discussed by Messrs. Forbes, Hopkins, Osborn, Smith, and Summers.

Mr. Forbes thought the entomologist might get some points on the preservation of the plants injured by insects from the horticulturist, and mentioned the preserved fruits at the World's Fair at Chicago as examples of good work of this sort.

Mr. Summers reported having at one time tested a considerable

number of the fluids used for the preservation of fruits, but had found none of them satisfactory.

Mr. Osborn thought that the aqueous preparations employed were open to the objection that they would freeze.

Mr. Smith had employed a method of killing and preserving larvæ similar to that described in the paper and agreed that alcoholic specimens as ordinarily collected and preserved were often of little use for the study of internal structures.

The following paper was then read:

THE DISTRIBUTION OF COCCIDÆ.

By T. D. A. Cockerell, *Las Cruces, N. Mex.*

[Read by the secretary in the absence of the author.]

It would be difficult to point to any group of insect pests the ravages of which have been more seriously increased by human interference than the Coccidæ. As a general rule, when one finds Coccids under strictly natural circumstances, they are local in their distribution, and their attacks are confined to one or two species of plants. But now that we continually carry plants from one country to another, we take with them Coccidæ of many kinds, and already some scale-insects are so cosmopolitan by human introduction, that it is very difficult to guess where they originally came from.

It is a matter of common knowledge amongst economic entomologists that the evils thus arising are on the increase; and I would submit to you that the outlook is a very serious one.* Even in the temperate zone you have become familiar with the injuries done by Coccidæ in countries where they are not indigenous; but in the tropics the state of affairs is beyond anything one could easily imagine, without having seen it. Coming to New Mexico from Jamaica, I experienced a kind of surprise at not seeing the leaves of the roadside trees spotted with Diaspinæ and Lecaniinæ, although I knew quite well that such appearances were not to be looked for so far north. In Jamaica, if instructing an inexperienced person to collect Coccidæ, it would almost be sufficient to say "gather leaves of various trees that grow about the town."

The luxuriance of tropical vegetation is such that the harm done by Coccidæ is not so great as one might expect from their abundance; but still, their presence is often the occasion of annoyance and injury to

* I here assume that anything which decreases the food supply of the human race is disadvantageous. This is not the place to discuss those artificial conditions, whereby abundance is made a cause of scarcity, and the wealth of some depends upon the want of others.

growers of field and garden crops. On the whole I see no reason to doubt that Coccidæ do more injury in the tropics than elsewhere, although their ravages have not very frequently been recorded; and probably there is no tropical country whose Coccid fauna is not at the present time being increased by introductions.

Having said so much, I wish to call your attention to a few facts which have come under my own observation, hoping to illustrate thereby the more important phases of the subject.

The number and variety of neotropical Coccidæ have not been sufficiently realized in the past, owing to the fragmentary nature of our information concerning them. At the present time those of the West Indies are better known than the species inhabiting the mainland, but even here the records are exceedingly imperfect. Jamaica has 61 recorded species, but Cuba has less than half a dozen, and I can not discover a single record from Haiti. The Coccidæ of the Bahamas are almost entirely unknown, although the Caicos and Turks islands have each produced an interesting endemic form. In the Lesser Antilles, thanks to Mr. C. A. Barber, Antigua has 16 records; but of the other islands only one has as many as half a dozen, the figures being Barbados, 7 (only 5 actually published); Montserrat, 4; Grenada, 3 (records not yet published); and Nevis, St. Kitts, and Dominica 1 each. Trinidad has 14 species (some not fully identified), but owing to the exertions of Mr. F. W. Urich, I shall shortly be able to add considerably to this figure. The Mexican list stands at the absurdly low figure of 26, which includes 12 found by the present writer recently while traveling through that country. It will be understood how insufficient are the published records when I mention that not one of the species I found was previously known from Mexico, so far as I have been able to ascertain. The list from British Guiana exceeds 20, but very few species are known from other parts of South America. For Brazil I find mentioned about half a dozen, for Chile 4, for Ecuador 1, and so forth.

Yet these beginnings of knowledge already indicate some interesting facts in geographical distribution.

Aspidiotus articulatus, Morg., is known from Demerara, Trinidad (St. Ann's, on *Pandanus*, coll. by F. W. Urich), Barbados, Nevis, Jamaica, and Mexico (Vera Cruz). It has not been detected in Antigua, where it must be absent or rare, else Mr. Barber would surely have found it.

Aspidiotus personatus, Comst., is known from Demerara, Barbados, Cuba, and Jamaica. I did not find it at Vera Cruz; and what is more interesting, Mr. Urich, after some search, has been unable to detect it in Trinidad.

These two species, where they occur, infest many kinds of cultivated trees and shrubs, and are quite noticeable. Up to the present time, neither has been detected in the United States, although if introduced they might probably manage to exist in the extreme South. Both prob-

ably are spreading through human means. *A. articulatus* probably originated in South America; but *A. personatus* is more likely a native of the Greater Antilles, its absence in Trinidad favoring this supposition.

Aspidiotus ficus, Riley Ms., Ashm., abounds in Jamaica, and is also known from Cuba and Florida. It is likewise common at Vera Cruz, Mexico. Probably it is a native of the Greater Antilles, but possibly of Mexico; it has apparently been taken to Japan, whence it was brought to California, according to Mr. Craw. It does not appear to occur yet in the Lesser Antilles, Trinidad, or Demerara. It is against its being of Mexican origin that I could not find it on oranges sold in that country, except at Vera Cruz, which is a most likely place for any scale to be imported. Mr. H. Tryon reports it from Australia.

This, like the two before mentioned, feeds on many plants. It seems probable that unless means are taken to prevent their introduction into various countries on plants, all three are destined to become universal in the tropics. Any one who has seen them in Kingston, Jamaica, where they all abound in the same locality, will appreciate the undesirability of this, from an agricultural and horticultural point of view.

Aspidiotus aurantii, Mask., has a very curious distribution: Australia, Tahiti, California, New Zealand, South Europe, and the West Indies. Who shall say where it originally came from? But the curious thing about it is, that in Jamaica it is not found on Citrus trees, but principally on lignum-vitæ (*Guaiacum*)—occasionally also on Cycas* (at King's House) and Areca. Its place on the Citrus trees in Jamaica is occupied by *A. articulatus*.

Apidiotus punicæ, Ckll., presents another instance of difference of food plant according to locality. In Jamaica it is found principally on pomegranate, never, so far as I know, on cocoanut; but in Dominica Mr. Barber found it infesting the cocoanut palm, just in the way that *Aulacaspis boisduvalii* infests it in Jamaica.

A fact that should not be lost sight of is, that tropical Coccidæ may be taken from one side of the world to the other, via hothouses in temperate climates. It is wonderful what a lot of interesting forms have turned up in hothouses in Europe. Signoret mentions no less than 48 found in such situations; and Douglas and Newstead have recorded several from greenhouses in England, the most recent addition being *Pseudinglisia rodrigueziæ*, Newst., which appears to be referable to my genus *Conchaspis*. Some time ago, I wrote to Kew, urging that an entomologist should be appointed to inspect the plants distributed by that institution to all parts of the world. Mr. D. Morris kindly replied in great detail, stating that at Kew they took all possible care, and that probably private importers and exporters were in most cases responsible for the wide distribution of certain Coccidæ. Be this as it may, it is clear that the scale insects manage to travel, and it is difficult to see how Kew or any large dealer in exotic plants can avoid transmitting

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* Mr. Cockerell subsequently wrote us that this is not *A. aurantii* but probably *A. dictyospermi* Morg.—*Eds.*

pests unless the plants are under the strict supervision of an entomologist. This leads one to think of quarantine regulations which have not yet been dreamed of in England; and so far as present methods go, no doubt Kew is altogether superior to the average of private firms, as Mr. Morris states. The consequence of this state of affairs is, that one never knows what will turn up in a given locality. *Chionaspis minor*, Mask., described from New Zealand, now proves to be common in the West Indies. *Dactylopius calceolariæ*, Mask., from New Zealand and Fiji, is discovered in Jamaica. *Lecanium mangiferæ*, Green, from Ceylon, is detected in Jamaica and Demerara. A Ceroplastes from Antigua, which I believe to be the same species as *C. cassiæ*, Chav., of Brazil, does not appear to differ from *C. dugesii*. Licht. MS., Twns. (of which I have specimens), from Mexico, and these again seem identical with the Indian *C. ceriferus*, Anders. Mr. Maskell pointed out this latter fact to me, and he has been so good as to forward Indian specimens of *C. ceriferus*, which seem to bear out his opinion as to the identity. I have all three now before me, but Mr. Maskell had only compared the Antigua form with *C. ceriferus*.

Such instances become more numerous as fresh information comes to hand. Thus *Asterolecanium* (*vel Planchonia*) *pustulans*, Ckll., known from Demerara, the West Indies, and Florida, was lately detected by myself at Vera Cruz, Mexico; and Mr. Maskell writes me that he knows it from Brazil and the Sandwich Islands. When I promised this paper, I thought of preparing something more elaborate than these few notes; but the distractions attendant on a change of residence, and the temporary detention of my books in Mexico City, through the blundering of a transfer company, have made it impossible to adequately gather together the statistics. Nor have I tried to discuss the distribution of Coccidæ within the United States, as I have nothing fresh of importance to contribute, and among those present are some doubtless much more competent to speak on this subject than myself. Yet the principles are the same throughout, and the evident indications are that we should endeavor to increase the knowledge of coccid distribution by all possible means, and so far as possible to prevent their importation into fresh countries. If my view is correct, now is the time to insist on the necessary precautions, as in fifty or a hundred years it will be altogether too late.

In conclusion I will give a list of the coccids I found this year in the Marine Gardens, Kingston, Jamaica. This locality is in the midst of the town, and it will afford an illustration of the coccid fauna of the island, as now found on cultivated plants. It may be seen at a glance that nearly all the species have been found in distant localities, and it may well be doubted if the scale insects as a whole belong any more to the original fauna of Jamaica than the plants on which they are found do to the flora.

Coccidæ of the Marine Gardens, Kingston, Jamaica, April, 1893.

Species.	Plants infested.	Distribution elsewhere.
1. *Dactylopius longifilis*, Comst.	On a palm; and 1 juv. on upper side of leaf of star-apple.	District of Columbia (under glass).
2. *Dactylopius virgatus*, Ckll..	Several juv. on leaf of coconut.	(Endemic so far as known.)
3. *Asterolecanium pustulans*, Ckll.	On pink oleander; very abundant and injurious.	Montserrat, Demerara, Florida, Mexico, Brazil, Sandwich Islands.
4. *Lecanium oleæ*, Bern.......	On Terminalia; on pink oleander, and many on twigs of star-apple, attended by ants.	Antigua, Mexico, California, Florida, South Carolina France, Australia, New Zealand.
5. *Lecanium terminaliæ*, Ckll.	On Terminalia................	Mexico.
6. *Lecanium hesperidum*, L...	One on a palm; found by my wife.	Mexico, Sandwich Islands, South Africa, Europe, Georgia, Utah, California, Florida, New York, District of Columbia, Ohio.
7. *Lecanium hemisphæricum*, Targ.	On an orchid; on a palm	Trinidad, Antigua, Montserrat, New Zealand, Pennsylvania, California, Australia, Europe (under glass).
8. *Ceroplastes floridensis*, Comst.	On oleander; on upper side of leaves of star-apple.	Florida, Louisiana, Barbados (on leaf, apparently *Chrysophyllum*).
9. *Aspidiotus articulatus*, Morg.	On oleander, with newly hatched larvæ, which are orange; on Citrus; on upper side of leaves of star-apple.	Nevis, Barbados, Trinidad, Demerara, Mexico.
10. *Aspidiotus ficus*, Riley MS., Ashm.	On upper side of leaves of pink oleander; on under side of leaves of rose; on Citrus; many on upper side of leaves of an orchid.	Cuba, Florida, Mexico, Japan, Kew (under glass), Australia.
11. *Aspidiotus sacchari*, Ckll...	On sugar-cane	(Endemic so far as known.)
12. *Aspidiotus personatus*, Comst.	On a palm	Barbados, Cuba, Demerara.
13. *Diaspis lanatus*, Ckll.......	On oleander....................	Antigua.
14 *Aulacaspis boisduvalii*, Sign.	On coconut, ♀ pale lemon yellow.	Barbados, Trinidad (Urich), Europe (under glass).
15. *Pseudoparlatoria ostreata*, Ckll.	On Acalypha..................	(Endemic so far as known.)
16. *Chionaspis minor*, Mask ...	On a palm	Trinidad, Antigua, New Zealand.
17. *Ischnaspis filiformis*, Dougl.	On a palm	Trinidad, Antigua, Grenada, Demerara, District of Columbia (under glass), London (under glass).
18. *Pinnaspis pandani*, Comst.	On coconut	Trinidad, Massachusetts (under glass).

Thus, of 18 species, all but three are known outside of Jamaica (and it is very doubtful if these are confined to the island, although not yet found elsewhere), while eleven have been detected outside of the neotropical region.

The following paper was then read:

NOTE AND RECORD KEEPING FOR THE ECONOMIC ENTOMOLOGIST.

By A. D. Hopkins, *Morgantown, W. Va.*

There is nothing of greater importance in the work of an economic entomologist than a well-organized system of keeping notes, records, and references. Especially is it important as a primary feature of the office and laboratory organization of the Experiment Station entomologist.

One of the objects of the law establishing the Agricultural Experiment Stations was to "stimulate original research and experiments

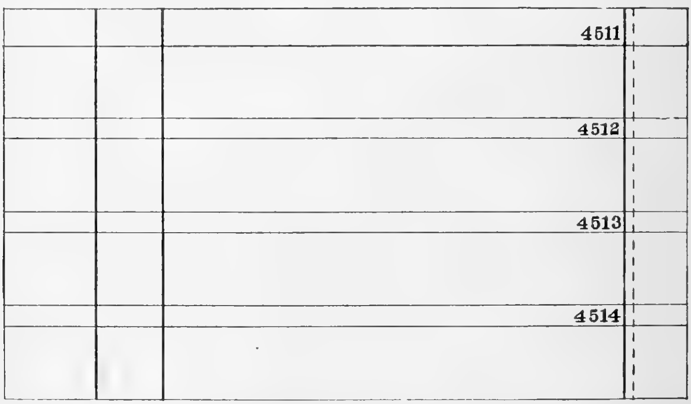
bearing directly upon the agricultural interests of the United States." Therefore it is necessary, in the exercise of our complicated duties as station entomologists, that we confine our attention especially to the discovery of new facts relating to the insects of the State or Territory in which we are located, and that we not only take many notes and make numerous records and references, but we should keep the valuable material thus gained according to some well-defined plan, in order that any portion or all of such information may be readily accessible in case it should be required for immediate publication or answer to inquiry.

In laying the foundation for entomological work at the West Virginia Experiment Station I have given special attention to this feature of the organization, and have worked out and adopted a system which has proved to be well adapted to the requirements of the character of the work in which I am engaged.

The system consists of an accessions catalogue and a species catalogue. These two catalogues contain or refer to all available information on identified and undetermined material in the collections, to all investigations, experiments, and observations, and to certain desirable literature relating to the identified species.

THE ACCESSIONS CATALOGUE.

This consists of a series of note pads or books, each containing 100 numbered spaces, in which entries are made referring to all numbered accessions to the collections, insectary or laboratory, also to numbered experiments, etc. The leaves of this pad are divided into spaces as shown in the following diagram, which is one-half the size of the pads I have used:



The spaces in the central portion are for localities, dates, names of accessions, numbers, and notes as indicated. The perforated transverse margin at the right is for detachable number and label slips, while the first transverse space at the left is for check-list numbers, names of species, and authority for identifications. The next space to the left is for name of host plant or insect.

The check lists referred to by check-list numbers are indicated by the first letter of the order represented placed immediately above the number.

The spaces on the note sheets are numbered by a consecutive numbering machine, and may continue from one to as high a number as desired. During collecting tours and other outdoor investigations, one of these pads, held in a case provided for the purpose, is carried in the pocket the same as an ordinary note-book. Entries are made in the numbered spaces at the time specimens are collected, and a corresponding number is placed with and remains with every specimen or set of specimens, experiment, etc., referred to. When entries have been made in all of the numbered spaces, the pad is taken from the case, the edges trimmed, and all surplus attachments removed. Then it is placed in the accessions catalogue file, and, as other pads are subsequently filled, they are filed with the first in consecutive order; thus forming from the first, and at any time after, a complete catalogue of all accessions.

THE SPECIES CATALOGUE.

This contains a complete list of the names of all the determined species in the collections, together with references to all notes, records, experiments, and investigations, and all other available information relating to each. The names, check-list numbers, accessions catalogue numbers, and other references are entered on cards or slips of uniform size ($6\frac{5}{8}$ by $4\frac{1}{8}$ inches), and the cards are arranged in systematic order according to the standard check list and synopsis of the order represented, and are filed in cases the same as the cards of an ordinary card index.

Two sets of cards are used for this catalogue. One called the species cards, and the other the record cards. The species cards have two spaces at the top, each five-sixteenths of an inch wide. The first space is for the check-list number or generic name. The second space is for the generic and specific name only, and the space below is for the synonyms, references to descriptions, classifications, corrections, etc. In no case should an entry be made on this card unless the species has been identified at least generically. If an identified species has a check-list number, the number alone will be sufficient to keep the card in its proper position in the catalogue file, but in case there is no check-list number for the species, the name of the order should be entered at the left in the upper space, the genus in the center, and the family at the right. This will facilitate keeping the species cards in their relative positions.

The record cards differ from the species cards in having but one space at the top. This space is for the check-list number, or if there is no check list in the order represented, the full name of the species is entered. The space below the line is for accessions, catalogue num-

bers, references to notes, experiment, in fact, all available information pertaining to the species represented by the check-list number.

The record cards are placed in the file with and succeeding the species cards, bearing a corresponding check list number or name. If the space on the first record card is not sufficient to accommodate all necessary entries. another is taken, and so on, using as many cards as may be required for all references or for full notes as desired.

All experiments, special investigations, and observations must have reference to some species of insect; therefore, in case it is found necessary to make a note or record having reference to a known species, of which specimens are not desired or can not be taken, instead of making the entry in the accessions catalogue, regulation record cards are used for the purpose, and the notes are entered under the name of the species, and the cards are placed in their proper positions in the species-catalogue file. In fact, if desired, the species catalogue may contain copies of all notes, records, descriptions, drawings, and all other material necessary for a full treatise or report on a species; or, in other words, any number of the record cards required for notes referring to a single species may succeed the species cards, provided they all bear the check-list number or name and have letters or Roman numbers in the upper right-hand corner to indicate their relative position in the series.

In order to explain a method of cross references used in this system, we will suppose that a set of pinned specimens, accompanied by their respective accessions catalogue numbers, are sent to a specialist for determination, and in due time we receive the list of names according to the accessions numbers. If the specimens belong to the order Coleoptera we take Henshaw's list and enter each of the accessions numbers immediately to the right of the corresponding specific name in the check list. Then we take the accessions catalogue and enter the proper check-list numbers in the spaces at the left of the notes bearing corresponding numbers to those of the determined species. The names of the species and their check-list numbers are then entered on the species card and references or full notes are copied on the record cards. After all necessary entries and cross references are made we place two labels on the pins bearing the determined example, or on duplicates having the same number. The first label bears the accession number and the name of the collector; the second label bears the check-list number, the name of the insect, and name of the person responsible for the determination. The specimens are then placed in their relative positions in the systematic reference and duplicate collections. As subsequent material belonging to a determined species is determined or added to the collection, the proper check-list number is entered in the accessions catalogue, and the pinned specimens are placed with the labeled specimens in the duplicate collection. The duplicate alcoholic, biologic, and economic material is placed in envelopes or packages which are marked with the proper check-list number and the name of host plant or insect.

ADVANTAGES OF THE SYSTEM.

Some advantages of a system of this kind may be mentioned as follows:

The check lists and monographs of the different orders are indexes to all determined material in the collections, and to all notes, records, and important literature pertaining thereto. They also show at once the number of species represented in the collection in any given order, family, or genus.

The accessions catalogue contains all original entries referring to all the determined as well as undetermined material.

The species catalogue may not only be an authentic catalogue of all the determined species in the collection, but, immediately succeeding the the name of each species, may contain reference to, or full notes of, all original observations, experiments, etc., together with references to available or desirable literature.

If at any time it is found that a species has been incorrectly determined, we have only to make the correction on the species card and change the check-list number or name on the record card and transfer the set to their proper places, leaving a card in the old position bearing a reference to the correction.

By means of the accessions numbers, check-list numbers and cross references all available information regarding any determined or undetermined species or specimens in the collection may be conveniently and quickly traced, either from the specimens to the notes or from notes to specimens.

In tracing from the specimens to the records the accession number on the specimen refers to the note in the accessions catalogue, where locality, date, food plant, and all other observations noted at the time the specimens were taken, together with subsequent notes and references, are found. If the specimen refers to an identified species the check-list number or name is found in the space at the left of the note; if a check-list number we are at once referred to the species catalogue, where references to records, etc., are found. If there is no check list for the order represented, and we find instead of the check-list number the name of the species, we turn to the index of the synopsis or monograph of the order represented to find the family and genus to which it belongs, after which we can easily find the desired information in the species catalogue by means of family and genus labels on projecting cards in the file.

In tracing from the note to the specimen, if relating to an identified species, we have only to find its family and generic position in the collection by reference to the check list or synopsis as we have just indicated. If referring to an undetermined species the specimens are found by means of the food-substance label under which the numbered specimens are arranged in consecutive order.

If we receive a bulletin or some late literature on the habits of certain insects represented in our collection, and we desire to know what our observations have been on the subject, we can quickly look it up, and at the same time enter a reference on the record or species card, to the literature in question.

On the other hand, if information is desired regarding a specimen among the undetermined material that we suspect belongs to an identified species, for instance, a small piece of bark or wood showing the larval mines of a bark beetle or wood borer, the accession number is, say, 4000. We turn to the accessions catalogue and find that the specimen is the larval mine of accession number 4001, which was a larva that had been reared to adult. We find that the adult had been determined and the check-list number entered in the space at the left of the note; thus, from any determined or undetermined fragment in the collections having reference to a determined species all available information regarding the species may be traced.

In conclusion, I desire to say that I do not wish it understood that I claim all the principles of this system of taking and keeping notes and records as original. No doubt some such system is in use by many of you here, differing mainly in being adjusted to suit your convenience and the requirements of your respective duties. As adjusted to suit the convenience and requirements of my own work it does contain some original features, which, I trust, may be of interest to some of you who are engaged with me in exploring the broad field of hidden facts open to the economic entomologist; facts that must be discovered and recorded in order to make our work more efficient.

Every note and record of original observations truthfully and systematically recorded will add materially to the advancement of the science. What may seem at the time trivial may, if recorded, lead to important discoveries, or prove to be the connecting link in the chain of facts making up the knowledge of the complicated life history and habits of some serious pest of the farm or forest.

Is it not important, therefore, in our life work that we not only make frequent entries in our notebooks, but that we keep our records of original observations and facts determined according to some well-defined plan that will enable us at any time to quickly trace up, for publication or other purpose all the facts we may have on a given species or subject, or in order that our successors may profit in finding our unpublished notes readily available?

In discussing this paper Mr. Smith said that he did not approve of the use of check-list numbers alone, and thought the name of an insect, as far as known, should always be given.

Mr. Osborn thought check lists should not be used. They are not available for all orders of insects. The names, he thought, should be written out in notes when possible.

Mr. Webster thought Mr. Hopkins' method too complicated. He used a notebook for his records, and gave a brief description of his method of entering notes as follows:

In my own practice I ignore check-list numbers and use the name of a species, combining in one book the accessions catalogue and the notebook, my numbers running consecutively year after year, and through volume after volume. I use square 12 mo. blank books, the first line containing the number, host, and species, thus:

825	Wheat. Isosoma tritici.
	June 29. Larvæ in straw, etc.

All specimens connected with any note are numbered the same as the note. If there are parasites their names follow the species on the upper line. When my book is filled I make a plant and an insect index referring to number of note and page of book, distinguishing these by black and red inks.

The following paper was then read:

ILLUSTRATIONS FOR THE ECONOMIC ENTOMOLOGIST.

By H. Garman, *Lexington, Ky.*

The important reason for illustrating writings is, I take it, to make the meaning plainer; to help to the recognition of objects not easily or satisfactorily described. A few movements of the pencil in drawing often make clear what could not be adequately described in a page of text, and the simple sketch so made will, with most of us, leave a more lasting impression on the mind. We do not often forget what we have seen. We more often forget things read about. The usefulness of figures for this purpose is abundantly attested by the increasing demand for them in all sorts of commercial work—in advertising, in journalism, in literary magazines, and in many departments of scientific work. It is probable that more new illustrations are now produced in a month than were issued in any year previous to 1870.

The great majority of such illustrations are intended to convey information and to save time in description. Finish and technique in drawing are consequently matters of secondary importance. They answer their purpose with the public when accurate in a general way and as far as possible self-explaining.

The public of the economic entomologist is not very different from the general public. It will not scrutinize an illustration very closely for details. It wants clearness first, finish next. But the position of the economic entomologist with reference to his public and to his subject is somewhat peculiar. If he published illustrations only for the use of

the agriculturist, figures accurate as to form and markings in a general way would be sufficient. Detailed drawing would be unnecessary. In the present state of applied entomology a considerable part of his work is in the nature of original investigation in the pure science of entomology. To him has been left often the work of describing and illustrating nice points of structure, of habit, of distribution, and the like, necessary to an understanding of the practical problems before him, and at the same time of the highest scientific value. If he is weak he may let this pure science of his work overshadow the more immediately practical science, and by publishing without discrimination technical illustrations and descriptions, endanger his success with the agriculturist. The farmer cares little about the number of denticles on the mandible of an insect, but he ought to know whether a given insect gnaws vegetation or punctures it. He does not care whether the wings of an insect are frenate or jugate, but, it may be, would like to know whether the owner flies readily from one field to another. He does not care at all about the structure of the ommatidium of a facet eye, but often wants to know very much whether an insect is black or brown, is banded or not, is one-fourth inch, or one-half inch long, and these are facts which the economic entomologist must keep before him in making illustrations for the agriculturist. He must produce figures that will be recognizable as likenesses; he must make accurate figures, for his own credit, at least, and if he can add to these two necessary qualities excellence of drawing, he may feel well satisfied with his work. Figures, showing only technical details of structure, are to be published as far as possible in the technical entomological journals, no matter how important to applied entomology such illustrations may be assumed to be. Attempts to combine what is intended solely for the entomologist with what is published for the agriculturist, sometimes work to the disadvantage of the latter. The fact that the entomologist does not suffer so much from this combination may account for the seeming failure of some good workers to recognize this defect in their published work. Reports on economic entomology have been published that are largely beyond the comprehension of the average farmer. The authors wrote, unintentionally I think, for the economic entomologist and not for the farmer.

Figures should be made of a size to be conveniently printed with text of the ordinary octavo page width. When possible all the stages of an insect should be represented, and when this is not possible from lack of time or material, let that stage be chosen which does the injury, if an injurious species, the one most likely to be encountered by the farmer. Besides such figures, others showing the nature of the injury done, or of the habitations of the insect are very desirable. In other words, show in illustrations what the farmer can observe and verify. He will never dissect out the mouth-parts of a flea-beetle.

A dorsal view of an insect is the one calculated to show most that is

characteristic, and when only one view can be made, is generally to be preferred. The legs can generally be shown to best advantage in the conventional position, that is, drawn out and symmetrically placed at the sides of the body. The wings of Diptera, Hymenoptera, Lepidoptera, Odonata, and the like, should generally be represented drawn out and placed symmetrically for the reason that they show in this position characteristics of venation, and markings are more easily drawn, and more readily compared with specimens. It requires something of the artist to show an insect in natural positions, of rapid flight for example, and most entomologists can not afford to attempt it. If a special draftsman is at one's elbow, the case is somewhat different. Awkward attempts, however, are worse than none, and it is not every entomological draftsman who is competent to do such illustrative work as that in "Sharp Eyes," by Gibson.

But supposing the objects to have been judiciously selected, how shall the drawings be reproduced? Must it be by cheap process, by wood engraving, by lithography, or by etching?

Etching, by leaving all the hand work to the draftsman, is theoretically a good method of making entomological illustrations. If the entomologist makes his drawing on the plate skillfully there is no chance for alteration afterwards, except as the subsequent mechanical work of biting in, and printing, may be poorly done. The special method of drawing called for, however, will deter most of us from attempting it. With only about thirty years for effective work at one's disposal it does not seem wise to expend energy in acquiring unusual methods, which may any day be superseded by something better and cheaper. The further fact that etchings can not be printed with ordinary type is an objection which ought always to prevent their use by the economic entomologist.

Lithography has furnished some excellent results to the entomologist. The French have shown themselves especially proficient in this method of making figures. Some of their work appears to me to be unrivalled for pure beauty and delicacy of execution. In the United States we have, with some very inferior work in this line, some very good examples of the lithographer's skill, as in Edwards's Butterflies of North America. But lithography costs too much for use by the economic entomologist. We can not afford to pay $200 or more for small editions of plates. We can't afford to use, except on special occasions, an illustration that can not be duplicated in the future. We do not want an illustration that can not be printed by the ordinary printer on the ordinary press. We want both illustration and text printed at one and the same time. The lithograph requires a special press, it can not be used again and again. And another objection to it is that it must be printed in plates, whereas it is often desirable to separate groups of plate figures and distribute them in text. It would seem that for the economic entomologist, the lithograph must always be an expensive luxury.

Wood engraving is better. It is not open to any of the objections against etching and lithography. It can be easily and cheaply duplicated. It yields a clear, neat figure when printed on only fair paper. It can be used in plates, or scattered in text. But it has one serious defect, namely, that the original drawing must be reproduced on the block and engraved by one who may not render it exactly. This is not so serious an objection when the engraving is in good hands, and especially when it is done by one who is accustomed to engrave for scientific men. But the best of engravers are liable to misinterpret some detail of a drawing, making the result far from satisfactory. At the same time it must be said that of our published figures woodcuts are the very best. The figures published by Prof. Riley in his Missouri reports are still among the best we have. We have none that have been so universally accepted and used in writings of all sorts. Even in so excellent a work as the Century Dictionary we find copies of some of these figures holding their own in quality with anything appearing there. It may be true that their success is not entirely due to the fact that they are woodcuts, but it is equally true that they would never have become so well known and universally used if they had been produced by any other method.

If the entomologist could transfer his drawing to the block and engrave it there, he might stop with woodcuts and bide his time until something better was produced. But life is too short. He can not afford to spend time learning to engrave. He knows that the man who attempts to make his own shoes and hat will get behind his fellows.

But the plain truth is that, with its disadvantages, wood engraving remains our most satisfactory method of making illustrations.

Cheap process* figures have of late all but displaced wood cuts in current literature, and appear likely to occupy most of the field. Their cheapness and the quickness with which they can be produced are their strong points as compared with wood engravings. For the newspaper and other transient literature they are appropriate and useful. For permanent literature, and especially scientific writings, it may be questioned if they have yet proved their right to be. They are often hard on the eyes, parts being too obscure for ready interpretation. The shaded figures sometimes impress one as if they were a little out of focus.

A good clean outline, almost or quite as good as a woodcut outline, can be obtained by some of these processes, if the original drawing is well made with a pen and good black India ink. Some of the figures in Dr. W. K. Brooks's Handbook of Invertebrate Anatomy are examples of good work of this kind, though the drawings are sometimes faulty,

*I do not include under this head heliotypy and other processes yielding blocks costing more than 20 cents per square inch of printing surface. Some of these give good results, but are too costly for general use.

by the Boston Heliotype and Printing Company. The plates in Hyatt and Arms' little book on insects (forming one of the series entitled "Guides for Science Teaching," published by D. C. Heath & Co.), while not always handsome, are clear and bold, never leaving one in doubt as to what the draftsman intended.

But the economic entomologist often requires something more than outlines and I have yet to learn of the cheap process which gives him the result in shaded figures showing patterns of coloration, sculpturing, and the like, that he should get. Certainly we have nothing in this line as good as first-rate woodcuts.

The process figures of our station bulletins do not average high. Some are decidedly bad. It is sometimes, of course, the result of poor drawing and printing, but more often, I think, of imperfections in the methods of reproducing them. It is sometimes evident that very good drawing has resulted in extremely bad printed figures.

Some of our best results in process figures are to be seen in the reports of the Agricultural Department at Washington and in INSECT LIFE. For mere beauty some of this work surpasses most wood cuts, yet it can not be considered entirely satisfactory, for reasons suggested above.

This much can be said for the cheap process figures, that they give promise of something better in the near future. It is very probable that within the next twenty years the processes will be so far perfected that they will yield as good results in every respect as the wood engraver now gives us. If it were not for the hopeful outlook in this direction the entomologist might well return at once to wood engraving. What I wish more especially to urge here is that we can not afford to rest satisfied with present achievement. The block-maker is sometimes inclined to give us work that might pass for transient literature, but should not be accepted for publication by a naturalist. By existing methods he can often do much better than he does. The naturalist should not be satisfied with careless work. It falls upon him to urge, by every means in his power, the improvement in process figures. His drawings should be made with extreme care, and, if necessary, adapted to the process employed in reproducing them. One very serious difficulty in the way of getting the most from our cheap processes is the unwillingness of the average draftsman to accommodate his drawing to the requirements of the process. When urged to make his drawings larger and his contrasts sharper, he sometimes replies that the block-maker should follow him, not he the block-maker. In other words, the inclinations and convenience of the artist should be considered before those of the mere maker of plates. No doubt the work of the draftsman is of prime importance whatever the process by which his work is rendered. But the fact remains that he can not get the best final results if he does not sometimes put aside some of his notions about high art and draw for the process. Looking at it from

the standpoint of the naturalist, it is hard to see wherein the artist bemeans himself or his art by working with sole reference to the final and permanent published results of his work.

This brings me to the matter of giving credit for drawings used in writings on economic entomology, with which I shall close. A good draftsman ought always to receive credit for his work. If he is something of an entomologist, as he should be in order to do some kinds of work, his initials may properly be placed by the side of his figures on the block. It is frequently the case, however, that drawings made by the entomological draftsman are more the work of the entomologist than of the one who used the pencil. Most of those who have had drawings of small insects or their parts made will probably agree that it is often harder work to get satisfactory results than it would be to make the drawings without help. In such case it appears fair to state, either in preface or elsewhere, that the drawings were made under the direction of the entomologist. Where the drawings are made by the entomologist alone he is of course entitled to place his initials by them, or indicate in any other way commending itself to his taste that they are from his pencil. When he copies the figure produced by a fellow entomologist the result should, in scientific writings at least, be credited as "after" the original figure. In station bulletins and elsewhere of late one sees well-known figures printed from electrotypes made directly from the original woodcuts, or else from electrotypes of these, credited in this manner. It would seem well to credit all such prints as "from" the author of the figure, not "after" him, using the latter term to indicate only such figures as have been redrawn.

In the discussion following the reading of this paper Mr. Osborn stated that photography seemed to him to promise good results in the way of furnishing figures, but that as at present used first-rate photographs were a necessity. The results obtained at present were, he believed, often bad largely because of careless printing or the use of poor paper.

Mr. Weed thought fresh specimens should always be selected for drawing, and considered photography more useful for making illustrations showing the work of insects than for figures of the insects themselves.

Mr. Smith considered line drawings superior to all others for process figures, and showed some excellent prints in several kinds of paper which he believed demonstrated that all the detail necessary in an illustration could be obtained by photography. To reproduce well the contrasts of a photograph must be sharp.

Mr. Hopkins stated that it seemed to him desirable to place a natural size figure of an insect by the side of the enlarged figure, as farmers

did not understand the meaning of the hair lines commonly used, and were often misled as to the real size of the insect pests.

Mr. Gillette agreed with Mr. Hopkins, and added that in his opinion it was often better to illustrate the work of a pest instead of giving figures of the latter.

Mr. Forbes inquired as to the printing of half-tone blocks on ordinary book paper. Messrs. Howard and Garman thought the cost of half-tone figures an objection for general use.

Mr. Smith replied that plates could be made for about $7 apiece. Messrs. Howard and Galloway stated that they cost the Agricultural Department at Washington from $10 to $20.

Mr. Gillette wished to know if there was any one in the country who could be trusted to make drawings of insects which were sent to him for that purpose. Mr. Forbes considered it very difficult in such cases to get results satisfactory to the entomologist.

Mr. Howard did not think the photographs shown by Mr. Smith demonstrated that better figures would be produced from them than were obtained from woodcuts, or even process drawings.

The following paper was then read:

THE ARSENITES AND ARSENICAL MIXTURES AS INSECTICIDES.

C. P. Gillette, *Fort Collins, Colo.*

The object in preparing the present paper has been to get together in a short article as much as possible of the important knowledge at our command concerning the arsenites as insecticides.

The article does not pretend to be an exhaustive one, and we have not been able to examine the extensive literature upon the subject as thoroughly as was desired, so it is probable that important matters have been overlooked and perhaps erroneous conclusions arrived at. It is hoped that such additions and corrections as those present are able to offer will be freely made during the discussion that will follow.

The value to this country of arsenical poisons for the protection of crops against insect injuries can hardly be overestimated. Arsenic in its various combinations is the great panacea for all the evils inflicted upon man by leaf-eating vermin. Through its use the value of our annual food supply is increased by many millions of dollars.

EARLY USE OF THE ARSENITES.

It is probable that we can never know with certainty who first used arsenic in any of its combinations for the destruction of insects, and it matters little that we can not.

A Mr. Bryan Markham, of Michigan, claims to have used Paris green for the destruction of the Colorado Potato-beetle as early as 1867, but

is unable to prove the date. Dr. C. V. Riley,* in Missouri, and Mr. George Liddel,† of Fairplay, Wis., both used Paris green for the destruction of the potato-beetle in 1868.

White arsenic seems first to have been used mostly in soluble form. In the report of the Entomologist (Report of the U. S. Department of Agriculture for 1884, p. 327) Dr. Riley speaks of arsenic being used as an insecticide in 1871, and we find no account of its use prior to that date.

London purple, so far as we can learn, was first put to practical use by Dr. Riley for the destruction of the Cotton Worm in 1878.

COMPOSITIONS AND PROPERTIES OF THE ARSENITES.

Arsenious acid (or arsenious oxide), As_2O_3, is the active principle in the arsenical combinations used as insecticides. Commercial white arsenic is practically pure arsenious acid. It is entirely soluble in ten parts of boiling or one hundred parts of cold water and has a specific gravity of 3.7. It is cheaper than either London purple or Paris green, and as it contains the active principle (As_2O_3) in larger proportion than either of these substances, it would, at first, seem reasonable that it should be most used as an insecticide, but it is not, and for several reasons probably never will be. Its white color is objectionable, rendering it liable to be mistaken for materials used in cookery. The powder mixes with much difficulty with water, and when mixed settles quickly on account of its high specific gravity.‡ When in solution it is so extremely injurious to foliage that it is not safe to use for the destruction of insects.

It is readily mixed, however, in a small amount of soapy or lime water and, on account of being least§ injurious of the arsenites when freshly mixed in water and applied, it is specially adapted for use upon tender plants. As it is only the dissolved arsenic in water that does injury to foliage, and as white arsenic is wholly, and London purple and Paris green but partially soluble in water, it seems strange at first thought that the pure arsenic should be least injurious. The reason evidently lies in the fact that white arsenic passes into solution much more slowly than the soluble arsenic in either London purple or Paris green. From the experiments of B. W. Kilgore (published in Bull. 77*b*, North Carolina Experiment Station, p. 6,) we find that one pound each of arsenic, Paris green, and London purple in a gallon of water had arsenic in solution at the end of one hour as follows: the arsenic mixture .053 grams, Paris green mixture .057 grams, and the London purple mixture .517 grams. At the end of ten days the arsenic mixture had seven times as much arsenic in solution as the London purple and fifty times

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*INSECT LIFE, vol. v, p. 44.

†Rept. of Ent. U. S. Dept. of Agr., 1884, p. 327.

‡Bull. 10, Iowa Exp. Sta., p. 404; Bull. 14, Ark. Exp. Sta., p. 5.

§ Bull. 2, Iowa Exp. Sta., p. 30; Bull. 10, Iowa Exp. Sta., p. 413.

as much as the Paris green mixtures. This explains why white arsenic if applied freshly mixed will injure foliage least, and after long standing in water most, of these three arsenites. A large number of applications of London purple, Paris green, and white arsenic in water to foliage, made by the writer at the Colorado Experiment Station during the summer of 1891 add increased evidence of the correctness of the above conclusions. White arsenic in the proportion of 1 pound to 16 gallons freshly mixed and applied to Osage Orange, Black Thorn, Apple, and Plum burned 7 per cent (estimated) of the foliage of Osage Orange as its greatest injury. One pound to 64 and one pound to 128 gallons produced very slight spotting of Plum leaves only.

During the present summer the writer has freely dusted pure powdered white arsenic upon the foliage of Box-elder, Elm, Plum, and Grape without producing any injury to the leaves.

PARIS GREEN.

This poison is an arsenite of copper and gives, on analysis,* about 68 per cent of arsenious acid (analyses differ considerably in the amount of arsenic obtained). It is said to be insoluble in water, but chemical †tests made at the North Carolina and New Jersey Experiment Stations show from 0.04 to 0.08 per cent of quickly soluble arsenic. The small amount of soluble arsenic in Paris green accounts for its being less harmful to plants than London purple as ordinarily applied. It should be remembered, however, that some have found Paris green more injurious to foliage than London purple, and that Prof. L. H. Bailey, aided by the assistant station chemist, reported in Bulletin XVIII of the Cornell Experiment Station that peach leaves burned by Paris green had no arsenic in their tissues and concluded that the injury was due wholly to external contact. Plants ‡ sprayed with dissolved arsenic at the Iowa Experiment Station in 1888 had arsenic in the tissue of the leaves after 48 hours. So it is possible that the injuries produced by Paris green upon plants, and its reputed quicker § and more certain action upon insects may be due to some property it possesses different in degree or kind from properties possessed by London purple or white arsenic.

It has also been stated by Mr. Woodworth (in Bulletin 14, p. 14, of the Arkansas Experiment Station) that Paris green is slower in its effects upon foliage than is either London purple or white arsenic. It is possible that some who have reported upon the injuries to foliage have not waited long enough to see the full effect. Not less than three weeks should elapse from time of application before final notes are taken.

* Bull. 18, Cornell Univ. Agr. Exp. Sta., p. 37; Ann. Rep. N. J. Exp. Sta., 1890, p. 526.

† Bull. 77*b*, N. C. Agr. Exp. Sta., p. 6; Ann. Rep. N. J. Exp. Sta., 1890.

‡ Bull. 2, Iowa Exp. Sta., p. 33.

§ Bull. 17, Ala. Exp. Sta., p. 6; Ann. Rep. St. Ent. of Ill., 1885 (experiments with Codling Moth); Bull. 12, Del. Exp. Sta.; Bull. 48, Cornell Exp. Sta., p. 272.

If the arsenites are to be applied in the old way, without the addition of lime or Bordeaux mixture, we must conclude, from all the evidence at hand, that Paris green is our most valuable arsenite for insecticidal purposes. About the only objections that can be raised to it are its higher price and its greater specific gravity than London purple.

LONDON PURPLE.

London purple is an arsenite of lime with impurities, principally coloring matter. Or, according to the analyses of Mr. H. Snyder, as published in Bulletin 18, p. 36, of the Cornell Experiment Station, London purple contains three calcium arsenites $Ca_3(AsO_3)_2$, $Ca(AsO_2)_2$, and $Ca_2(As_2O_5)$, amounting to about 72½ per cent of the entire weight of the commercial article. The impurities as given by the same authority are 23.04 per cent coloring matter, small amounts of Fe_2O_3, Al_2O_3, SO_3, and water.

The total solubility of this arsenite in water Mr. Snyder found to be 52.38 per cent. The fact that so large a portion of London purple is quickly soluble in water accounts for the serious injuries that it often does to foliage. But as we are able by the addition of lime or Bordeaux mixture to prevent these injuries, it must be ranked, on account of its cheapness and the readiness with which it remains in suspension in water, as second to none of the arsenites as an insecticide unless it be found true that it is less effectual in destroying insects.

OTHER ARSENITES.

A few other arsenites deserve passing mention because of their having been used for the destruction of insects rather than because of any great value that has yet been attached to them for insecticidal purposes.

ARSENITE OF AMMONIA.

In the report of the Entomologist of the U. S. Department of Agriculture for 1889 (p. 357), is printed a statement from the pen of Miss Mary E. Murtfeldt, saying she found arsenite of ammonia more injurious to foliage than arsenic in a watery solution, and in Bulletin 23 (p. 55) of the Division of Entomology, Miss Murtfeldt reports the same solution destructive both to leaf-feeding insects and to foliage. In the report of the Entomologist of the Department of Agriculture for 1890 (p. 264) Mr. Osborn, of Iowa, reports upon experiments with this substance and says he found it as effectual as London purple or Paris green for the destruction of insects and not injurious to foliage.

ARSENITE OF POTASH.

This arsenite, which is soluble in water, was reported by Mr. R. W. Jones in Bulletin 1, Division of Entomology (p. 51), as effectual in destroying Boll Worms on cotton. Of its effects on foliage nothing is said.

ARSENITE OF SODA AND FOWLER'S SOLUTION OF ARSENIC.

These have also been used for the destruction of insects, but have been discarded probably on account of their cost and injurious effects upon foliage.

ARSENIURETTED HYDROGEN GAS.*

This gas has been used with success by D. W. Coquillett in California for the destruction of scale-insects affecting the Orange.

ARSENICAL MIXTURES.

Within a few years past it has been found advantageous to apply the arsenites along with other substances, and chiefly for three reasons: (1) to economize time where an arsenite and a fungicide are needed upon a plant at the same time; (2) to prevent the injuries that the arsenites usually do to foliage; (3) to increase the effectiveness of the poison by using with it some sticky material as flour, paste, or molasses to make it adhere longer and in larger amount upon the leaves.

Who first conceived the idea of combining the arsenites with fungicides it would be impossible to say. The earliest mention we have been able to find of anyone having used an arsenite with a fungicide for the purpose of destroying both insects and fungi is by Mr. C. M. Weed, in Bulletin 7, vol. II, of the Ohio Experiment Station (September, 1889). The application was reported to have destroyed Potato-beetles and lessened the attack of the blight.

Now such mixtures are commonly recommended, but some of the fungicides, on account of their solvent action upon the arsenites, cannot be safely used with the latter upon plants.

†It has been proved by experiments that London purple, Paris green, and white arsenic when applied upon foliage along with Bordeaux mixture do less injury than when applied in water alone; †that London purple and Paris green are not more injurious to foliage when applied in ‡resin mixture; that foliage will suffer greater injury when arsenites are used in §sulphate of copper solution, strong soapy mixture, ‡Eau celeste or ||iron chloride solution.

Whether the arsenites may be used with ammonia carbonate of copper or not there seems to be a difference of opinion and experiments are needed to decide the matter. One important question then that should always be decided before recommending the mixture of any substance with an arsenite to be applied to plants is, how will the substance added affect the solubility of the arsenite. ¶If it renders it

* Rep. of Ent., Dept. of Agr., 1888, p. 127.

† Bul. 10, Iowa Exp. Sta., p. 417; Bul. 4, vol. III, 2d Series, Office Exp. Sta., p. 143; Bul. 48, Cornell Exp. Sta., p. 274; Bul. 77*b*, N. C. Exp. Sta., p. 5.

‡ Bul. 10, Iowa Exp. Sta., p. 415.

§ Bul. 10, Iowa Exp. Sta., p. 418.

|| Bul. 77*b*, N. C. Exp. Sta., p. 8.

¶ Bul. 77*b*, N. C. Exp. Sta., p. 10.

more soluble, it will cause it to do greater injury, if it renders it less soluble it will cause it to do less injury to foliage. In applying arsenites and fungicides together the benefit is not wholly in economizing time or lessening the injuries to foliage. Mr. Lodeman, of the Cornell Experiment Station, has reported (Bul. 48, p. 272) decided fungicidal properties for London purple and Paris green.

ARSENITES WITH LIME TO PREVENT INJURY TO FOLIAGE.

So far as we are aware, lime is the only substance used with the arsenites for the express purpose of diminishing the injuries that they ordinarily do to plants, and the first experiments made with this object in view seem to be those reported in Bulletin 10 of the Iowa Experiment Station. These experiments proved beyond a reasonable doubt that London purple or Paris green can be used liberally in wet applications upon the tenderest foliage when there is a little lime in the water. The results reached in Iowa have been abundantly verified since by the writer in Colorado, and by * other entomologists in several States.

Just the amount of lime necessary in each case to precipitate the soluble arsenic, and so protect foliage from injury, was determined at the New Jersey Experiment Station † by Dr. J. B. Smith with the aid of the assistant station chemist, and also by Mr. B. W. Kilgore, assistant station chemist in North Carolina. ‡

Dr. Smith recommends foreach pound of London purple three-fourths of a pound of lime; for each pound of arsenic, 1½ pounds of lime; and for Paris green a small amount. Mr. Kilgore recommends for London purple and Paris green equal weights, and for arsenic a double weight of lime. In either case the amounts recommended are in excess of what would be needed as indicated by the analyses.

What seems unaccountable to the writer is that in all his experiments, both in Iowa and Colorado, lime added to a fresh mixture of arsenic in water and applied to foliage has in all cases resulted in much greater injuries than when arsenic was applied in the same manner without lime. When the arsenic was first dissolved in the water lime would lessen the injuries as in the case of London purple and Paris green.

ADHESIVE SUBSTANCES USED WITH THE ARSENITES.

§ When flour paste or other adhesive substance is used with arsenical mixtures, wet or dry, the poison should be used more sparingly, as anything that will cause more arsenic to adhere to the leaves will cause increased burning of the foliage.

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* Bul. 4, No. 2, Ohio Exp. Sta.; Bul. 75, N. J. Exp. Sta.; Bul. 77*b*, N. C. Exp. Sta.

† In Rep. of Exp. Sta. for 1890.

‡ Bul. 77*b*, N. C. Exp. Sta.

§ Bul. 10, Iowa Exp. Sta., p. 408.

ARSENITES WITH KEROSENE EMULSION.

Agents of the Division of Entomology* and others† have experimented with the arsenites in kerosene emulsion for the destruction of haustellate and mandibulate insects with one application, but the combination has, so far, proved a failure.

In such a mixture the arsenite will separate in buttery clots and rise to the surface or cling to the inside of the vessel, and the separation of the oil from the emulsion is also hastened.

There seems to be no reason why the arsenites could not be used with pyrethrum.

THE ARSENITES AS EXTERNAL IRRITANTS.

The arsenites are usually thought of as only being destructive to insect life when taken internally.

In the report of the Michigan board of agriculture for 1888 Mr. L. H. Bailey, of South Haven, Mich., is reported as saying he had been entirely successful in ridding horses of ticks and cattle of "black lice" with a single application of London purple in water.

Mr. H. Garman (in Bul. 21 of the Kentucky Exp. Sta.) says he has found London purple more destructive than pyrethrum when applied to plant-lice.

In the Report of the Entomologist of the U. S. Department of Agriculture, 1890 (p. 142), Mr. D. W. Coquillett reports success in destroying scale-insects with arsenic, in combination with each of the following mixtures:

Muriatic acid, mercury and quick lime.
Muriatic acid, zinc and quick lime.
Muriatic acid and zinc.
Muriatic and nitric acids, mercury and quick lime.
Muriatic and nitric acids and copper.
Muriatic and nitric acids and zinc.

And in the Report of the Entomologist of the U. S. Department of Agriculture, 1886 (p. 557), Mr. Coquillett reports having used the arsenites successfully in the proportions of 1 pound to 4 gallons, 1 pound to 6 gallons, and 1 pound to 8 gallons of water for the destruction of scale-insects. So the arsenites should not be considered poisons that kill only when taken internally. They are of some, perhaps much, importance as external irritants also.

In the discussion Dr. Beal suggested that it might be desirable to regulate the amount of arsenic in Paris green by law.

Mr. Weed thought London purple more constant in the amount of arsenic it contained than Paris green, but Mr. Gillette believed the reverse to be true, and thought the general testimony was to this effect.

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*Rep. of Ent. U. S. Dept. of Agr., 1886, p. 557.

†Bul. 10, Iowa Exp. Sta., p. 414.

Mr. Galloway remarked on the peculiar invigorating effect which Bordeaux mixture has when sprayed on plants, even when they are not diseased or injured in any way. The solutions of carbonate of ammonia on the contrary were known, when constantly used on vegetation, to have a very injurious effect in course of time.

On invitation from the members of the Association Mr. Galloway, of the Division of Vegetable Pathology at Washington, gave a brief account of some recent work done in his Division on a widespread bacterial disease of melons and other related plants. It had been found to be disseminated very largely by the agency of insects, among which were *Diabrotica vittata*, *D. 12-punctata*, and an Epitrix. The disease appears suddenly among vines, and in the course of a few hours they become wilted as they would if cut off by the roots. Eventually they die completely. Several species of bacteria were found in the tissues of the affected plants by Dr. Erwin F. Smith, and at least one of these was, after isolation, capable of producing the disease when introduced into sound plants. Of hundreds of cases examined all had been started by the work of insects, and it was found that the plants could be completely defended from the disease by covering them so as to exclude insects.

Mr. Webster had observed the disease in Ohio where he had witnessed its occurrence in groups of plants. He had experimented with a view to checking it by applications of Bordeaux mixture.

Mr. Smith found it very common also in New Jersey.

Mr. Garman had observed the same disease in Kentucky.

The President announced that a free boat ride on Lake Mendota was offered to members of the association by the American Microscopical Society.

On motion the association then adjourned to meet at 2 o'clock.

THIRD SESSION—AUGUST 15.

The association was called to order by the president at 2 p. m.

Mr. Webster, as chairman of the committee appointed by the chair to consider means of raising funds to pay the annual expenses of the association, reported as follows:

Your committee beg leave to report that they have examined the constitution and by-laws concerning membership fees and dues and propose the following:

ARTICLE II, Section 2. Omit the words, "assessment of not less than 25 cents on the members in attendance at the meeting," and substitute therefor the words, "annual dues of 50 cents, to be paid to the secretary within one month after the meeting by each resident member."

F. M. WEBSTER, *Chairman.*
JOHN B. SMITH.
A. D. HOPKINS.

On motion the report was adopted.

Mr. Webster offered a resolution relating to the publication of the proceedings of the present meeting, as follows:

Resolved, That we respectfully request the publication as heretofore of the proceedings of the present meeting in INSECT LIFE, and that the secretary be requested to prepare the same for publication, and that he be asked to prepare an abstract of the proceedings for publication in the *Canadian Entomologist*.

The resolution was adopted.

Mr. Aldrich, of Idaho, proposed Mr. G. C. Davis for membership.

It was moved by Mr. Webster that the chair be requested to appoint a committee of three to nominate officers for the coming year.

The President called attention to section 3 of Article II of the by-laws, in which unanimous consent of the voting members is required to suspend the regular method of electing officers by ballot after open nomination.

It was voted this consent be granted, and the chair then appointed on the committee Messrs. Osborn, Webster, and Weed.

The following paper was then read:

DESTRUCTIVE SCOLYTIDS AND THEIR IMPORTED ENEMY.

By A. D. HOPKINS, *Morgantown, W. Va.*

Within the last three years enough evidence has come under my observation of the destructive powers of Scolytid bark and timber beetles to convince me that they are among the worst enemies of our forest trees. In fact it is my belief that bark and timber beetles have caused the loss of more property, having a commercial value in West Virginia, within the last ten years than that occasioned by any other single class of insects within the same time.

The destruction in our pine and spruce forests alone, resulting from the primary attack of a single species of bark beetle, has caused, since 1890, the loss of timber having a value of not less than a million and a half dollars.

Certain great devastations in the spruce forests of Maine, New Hampshire, New York, New Brunswick, France, and Germany since 1860 were evidently the work of bark beetles, which, aided by timber beetles, not only cause the death of trees, but so damage the wood and hasten its decay that the timber soon becomes worthless, and in this country proves almost a total loss.

The destructive species of Scolytids may be divided into two classes, one class, including only a limited number, makes the primary attack, or prefers to enter the bark, roots, and wood of living trees and other plants. The other class has a preference for injured, unhealthy, or felled trees, etc., the bark and wood of which these insects infest for the purpose of perpetuating their species. The first is primarily to blame for causing the death of trees, or at least a diseased condition, while the

second is responsible for the death of the diseased ones and for causing the premature decay of the wood. All bark and timber beetles are, therefore, more or less destructive in their habits, their power of destruction depending more than anything else perhaps upon their numbers.

Nature has provided plant life with the power, to a certain extent, of resisting the attack of enemies and with natural means of healing wounds, recovering from disease, and other injuries occasioned by severe drought, cold, etc. Therefore, in order for a single species of insect enemy of a tree to attack and kill it it must not only infest a vital part, but must occur in sufficient numbers to overcome all resistance. This is especially the case with destructive Scolytids, which, to accomplish this end, must enter the bark or wood of living trees, where they meet with the flowing sap, which offers the greatest resistance and most difficult to overcome. Therefore, no single species of Scolytid bark beetle can cause the death of large or small forest trees unless occurring in immense swarms. In fact, it is doubtful if any single species could overcome the resistance thus offered by vigorous, healthy trees without the assistance of numerous species of Scolytids and other insects which always come as reënforcements after the first attack is made. Hence, to cause a widespread devastation of timber, numerous species must work in concert. One species makes the primary attack and causes at once an unhealthy condition of the bark and tree. This diseased condition, if ever so slight, attracts other species to the affected tree. One or more kinds will attack the bark and wood at the base, others attack the bark at different points on the trunk, others infest the large and small branches, while still others enter the bark and wood of the terminal twigs, until the infested trees may be the hosts of twenty-five to forty species of Scolytids, each aiding the other in making the conditions favorable for the perpetuation of their species, and all contributing to the death and premature decay of their host.

Thus, through certain favorable conditions (the increased numbers of the species which are capable of existing in the green bark of living trees being the most favorable), an invasion may be started which in a few years results in the loss of millions of dollar's worth of property.

The fact that the primary attack of one species makes the conditions favorable for the increase of others, which in turn contribute to the increase of the first, is an important feature to be considered, in our effort to discover methods of checking or preventing the ravages of this class of insects. If the numbers of those making the primary attack can be reduced below their power of causing a diseased condition of the trees, the trouble of which they are the primary cause must end. If, on the other hand, their undue increase can be prevented, invasions by them can not occur.

Thus, it is evident that, before considering a remedy against an invasion of Scolytids, we must discover the species to blame for the pri-

mary attack, and become as familiar as possible with its life history and habits, as well as the life history and habits of other species coöperating with it, and also study other causes which might contribute to or oppose the progress of their destructive work.

In the consideration of preventive measures against invasions of Scolytids, we must study the habits of the different species of the family in order to ascertain which of them are capable of causing diseased conditions of trees, or through increased numbers, their death.

During an investigation of serious trouble caused by these insects in our State I have given especial attention to these subjects. After discovering the species to blame for the primary attack, and its principal aids in continuing the devastations, methods of checking the increase of the destructive kinds and protecting forests of healthy timber from their invasions were considered.

I was convinced from the first that no artificial remedy, such as cutting and burning the infested trees, the removal of the bark from the trunks, etc., could be successfully applied in our West Virginia forests. Therefore, my attention was turned toward the study of the parasitic and predaceous enemies of Scolytids, with a view of ascertaining the most desirable kinds with which to conduct experiments, in utilizing them as a means of checking the increase of the destructive species.

An enemy of Scolytids was desired which would not have to depend on one or two species for its existence, but could readily adapt itself to different species and to varying conditions.

I found that while Scolytid bark beetles have numerous parasitic Chalcidid, and Braconid enemies, few, if any of them, in my opinion, can be relied upon as introduced enemies to suppress or prevent an invasion of these beetles. I found, however, among their predaceous enemies, that the habits of certain species of the coleopterous family Cleridæ were such, if these beetles occurred, or could be introduced in sufficient numbers in the infested forests this would certainly have the desired effect.

In my search for literature regarding native and European Clerids I found, in a report upon forestry, by F. B. Hough, 1882 (p. 264), as copied from a special publication of the French Forestry Administra, in connection with the Universal Exposition at Paris, that a European species, *Tillus formicarius*, was mentioned as being a "foe of *Bostrichus typographus* that pursued them without mercy" during an invasion of these bark beetles in the forest of *Abies excelsa* in the Jura mountains, from 1868 to 1872. This led me to make further inquiries in regard to this and other European enemies of Scolytids and on October 13, 1891, I wrote to my correspondent, Oberfoerster W. Eichhoff, of Strasburg, Germany, asking him to send me some pinned specimens of insects known to be special enemies of European Scolytids. At the same time I indicated to him my desire to introduce live examples of

such species as in his judgment would prove beneficial in this country as natural enemies of *Scolytus rugulosus*, *Polygraphus rufipennis*, *Dendroctonus terebrans*, and *Dendroctonus frontalis*. Among the thirty-one species of pinned specimens received from him on November 12, he mentioned *Clerus formicarius* as being "beyond a doubt the best destroyer of Scolytids."

On May 30, 1892, I again wrote to Mr. Eichhoff, mentioning the damage to our forests by *Dendroctonus frontalis*, and stated that I was very anxious to try the experiment of introducing *Clerus formicarius* into our forests as an enemy of this and other bark beetles. In his reply of June 26 he referred me to Director C. Schaufuss, of the museum at Meissen, Saxony, as one who could give me efficient aid in this matter. Upon further investigations of the ravages of the bark beetles in our forests I prepared a special report, dated July 9, which was addressed to the principal owners of the spruce and white pine timber in West Virginia. In the closing paragraph of this report, reference was made to the successful introduction of the Vedalia into California, and the possibility of introducing in a like manner insects from Europe which would feed upon the Destructive Bark-beetle. It was suggested that it might be necessary to make a special trip to France and Germany for this purpose, and that if the timber interests of the State would share in the expenses of such a venture, this object might be speedily accomplished. In reply to this communication six of the principal timber companies of the State responded with liberal contributions, and I was authorized to proceed at once to Europe for the purpose of studying the insect enemies of European Scolytids, and to collect and import to this country such species as in my judgment would prove efficient in checking the ravages of insects in our forests.

In studying the enemies of European Scolytids, I found, as in this country, numerous Hymenopterous and Coleopterous parasitic and predaceous species in company with the Scolytids in the bark of the infested trees, but realizing to the fullest extent the danger of introducing insects into this country which might prove injurious as well as beneficial, I took every precaution in the selection of the species. Out of quite a number of enemies of Scolytids observed and considered, only one, *Clerus formicarius*, was selected, primarily on account of its being regarded as the greatest destroyer of European bark beetles; secondarily on account of the general opinion of entomologists and forest officials whom I consulted, and my own convictions from a personal study of its habits, that it would not be injurious.

The first examples of this European bark-beetle destroyer collected by me were taken in the Hagenau forests of *Pinus sylvestris*, on August 29, in the first injured tree examined, and they were afterwards found common in the larva, pupa, and imago stages in their pupa cases or winter quarters in the outer bark of large and small trees which had been injured or broken by storm and heavy snow. The bark of these

injured trees was infested principally by the common European bark beetles, *Hylesinus* (*Myelophilus*) *minor* Hart., and *Hylesinus* (*Myelophilus*) *piniperda* Linn. The larva of the Clerid had evidently been devouring the larva and pupa of the latter species at a fearful rate, for in many instances, scarcely one had escaped where there had apparently been thousands. The Clerid was also found under the same conditions in the forests near Meissen in the Kingdom of Saxony, and were taken from the bark of spruce logs in the Lauterbrunnen Valley in Switzerland, where they had been feeding on *Tomicus cembrae*, Heer.

Upon my return to this country, with something over a thousand specimens, a small colony of the beetles and larvæ were placed in a pine woods near Morgantown, on October 10, 1892, being the first examples set free in America. The remainder were successfully kept over winter in the larval and pupal stages, and between April 20 and May 10 they were distributed to the timber companies which had contributed to the expenses. Colonies of 25 to 100 were placed by me, or under my special supervision, on and in the bark of trees, logs, and tops, where the conditions were most favorable for their propagation.

Eight importations, numbering 2,082 examples, have since been received from collectors in Alsace and Saxony, Germany, and the living examples have been sent to the timber companies in five different counties, with special instructions for their proper location in colonies the same manner as first mentioned. In all 26 colonies have been placed in different sections of our forests. The conditions surrounding each colony are most favorable for the clerids to thrive and increase, and we have every reason to believe that they will do so under their changed conditions, but as yet we have no means of ascertaining to what extent they have multiplied, and of course it is too early to expect results.

There is one interesting fact, however, that I have observed this season regarding the destructive Pine Bark-beetle *Dendroctonus frontalis*, and that is that its numbers have been very greatly reduced since last fall, consequently at this time very little if any timber is dying.

On the 24th of July, 1892, I found this species attacking and mining beneath the bark of living trees, in which they occurred in immense numbers. By the latter part of September a brood had emerged from the bark of the same tree while the leaves were yet green, and those that had emerged were entering the bark of other living trees. In November the bark of the same trees were found to be infested by countless thousands of the insects in all stages from eggs to adults. Trees so affected subsequently died, but through persistent search in the bark of such trees in different sections of the State I have failed, as yet this season, to find a single living example of *Dendroctonus frontalis*. Hence the trouble, as caused by this species, is evidently at an end in West Virginia, for the present at least.

No other species of Scolytids infesting the same trees seem to have been affected by the cause which it would seem has rendered *Dendroctonus frontalis* almost extinct. In fact the great number of trees that died last summer and fall were found last spring to be infested by immense numbers of bark and timber beetles of different species. These have since emerged, and it would seem that the only danger to be apprehended from a continuation of a trouble like that we have mentioned would be from the attack of some of the species which have thus emerged from the dead trees, for it is evident that unless they find favorable conditions in the felled trees, tops, stumps, etc., in lumbering regions they must either attack and kill living trees or they must perish.

One species, the Turpentine Bark-beetle, *Dendroctonus terebrans,* has already made a desperate effort in this direction. Early in May the adults emerged from the trees in which they had bred, but failed to find dying trees, the bark of which they preferred to infest for the purpose of depositing their eggs. Then followed a remarkable and interesting occurrence, probably never before observed in the life habits of this and other species of Scolytids. They, with numerous other members of the Scolytid family, including both bark and timber beetles, must have started, with one accord, in search of more favorable conditions for their propagation, for they occurred in different sections of the State, at about the same time, in great swarms like migrating locusts. Specimens were sent to us accompanied by startling accounts of plagues of bugs that invaded mill yards, furniture shops, newly painted houses, etc. They were reported as coming like a hailstorm against the windows, and in at the open doors like swarms of bees, and that the air on all sides was full of them. During my absence from Morgantown (where our station is located) one of these migrating swarms of Scolytids invaded the town and occurred at certain houses and at furniture factories in such immense numbers that some of the people became alarmed. The report was started that Hopkins's German bugs had devoured all of the pine bugs and were going to prove like the English Sparrow, a universal pest. It was probably well for me that I was absent at the time.

The men were painting a new greenhouse at the station at the time, and the number of the beetles attracted to the building evidently by the odor of turpentine, were so great that the men were exceedingly annoyed in their work. When I returned to the station, several days after, I found evidence of their numbers in the handfuls of dead beetles that failed to escape from the greenhouse.

Dendroctonus terebrans occurred in by far the greater numbers in these migrating swarms, and when they failed to find dying or injured trees they attacked living Pine of all kinds, Black Spruce and Norway Spruce, entering the bark at the base of the trees. Some of the trees thus attacked in May were examined July 15, and the bark near the point of the attack was found to contain parent adults, eggs, and full-

grown larvæ, the larvæ occurring in great numbers surrounded by the flowing turpentine. Trees thus infested were still living but the injury will probably cause a diseased condition of the trees, which will attract other species and result in their final death, thus we may be on the eve of a new destructive invasion like that which has just passed. Other species, like *Polygraphus rufipennis*, *Tomicus calligraphus*, and *Tomicus cacographus*, which are capable of existing in green, sappy bark, occurred in such abundance in the dying spruce and pine trees last spring that it is evident they must exist in the forests in great numbers, and are ready to attack trees showing the slightest indication of disease or weakened vitality, if they do not make a primary attack.

Therefore, the imported enemy will find abundant food and favorable conditions for its rapid increase in the infested bark of felled trees, tops, and stumps in lumbering regions in which or near which the colonies have been placed.

The imported Clerid does not confine itself to one or two species of bark beetles in one kind of trees, but the adults, it would seem, will attack and devour the adults of any species of bark and timber beetles found in the United States, and their larva will feed on the eggs, larvæ, pupæ, and young beetles of any species infesting the bark of pine and spruce trees. In fact, they are inclined to make themselves generally obnoxious to the little bark pests.

It would seem that all of the conditions necessary for the imported Clerid to multiply and become an efficient protector of our pine forests from future destructive invasions of bark beetles are most favorable. *Dendroctonus frontalis*, evidently the most destructive enemy of our pine forests, has, from some cause, been reduced far beyond its destructive powers. Other species which have depended upon it for the primary attack are, it would appear, somewhat demoralized on account of the disappearance of their benefactor. The large amount of felled timber found in the several lumbering regions will probably attract the larger portion of other threatening bark beetles away from the green trees, and by the time *Dendroctonus frontalis* can again marshal sufficient forces to successfully attack and kill the trees, they will, it is hoped, be met with a force of enemies led by the European Bark-beetle Destroyer, which will successfully repel them and thus save our forests in the future from destructive invasions of bark beetles.

Mr. Smith, in discussing this paper, said that he thought the experiment entered upon in West Virginia well conceived, but thought that parasites did not greatly benefit the farmer. Mr. Hopkins, in reply, stated that it required enormous numbers of the Scolytids to kill the pine trees, and that his idea was to get some means of reducing the numbers of the beetles and not to completely exterminate them. That parasites

were a benefit to agriculture was, he thought, demonstrated by the irruptions of pests which took place when, by some means, they reached localities from which their parasites were absent.

The following paper was then read:

PARASITIC AND PREDACEOUS INSECTS IN APPLIED ENTOMOLOGY.

By C. V. Riley, *Washington, D. C.*

The importance to man, and especially to the agriculturist, of the parasitic and predaceous insect enemies of such species as injure vegetation, has been recognized by almost all writers on economic entomology. Indeed, it is a question whether the earlier writers did not attach too much importance to them; because, while in the abstract they are all essential to keep the plant-feeding species in proper check, and without them these last would unquestionably be far more difficult to manage, yet in the long run our worst insect enemies are not materially affected by them, and the cases where we can artificially encourage the multiplication of the beneficial species are relatively few. While fully appreciating the importance of the subject, therefore, it is my purpose in this paper to point out the dangers and disadvantages resulting from false and exaggerated notions upon it.

There are but two methods by which these insect friends of the farmer can be effectually utilized or encouraged, as, for the most part, they perform their work unseen and unheeded by him, and are practically beyond his control. These methods consist in the intelligent protection of those species which already exist in a given locality, and in the introduction of desirable species which do not already exist there.

The first method offers comparatively few opportunities where the husbandman can accomplish much to his advantage. That a knowledge of the characteristics of these natural enemies may, in some instances, be easily given to him, and will, in such instances, prove of material value, will hardly be denied. The oft-quoted experience which Dr. Asa Fitch recorded, of the man who complained that his rosebushes were more seriously affected with aphides than those of his neighbors, notwithstanding he conscientiously cleaned off all the old parent bugs (he having mistaken the beneficial ladybirds for the parent aphides) may be mentioned in this connection. Other cases will recur to you and I will mention one rather striking experience related by my assistant, Mr. L. O. Howard. The Army Worm (*Leucania unipuncta*) was overrunning a large and valuable field of timothy and threatened the destruction of the adjoining fields. The insect was as yet, however, circumscribed, and susceptible of remedial treatment. The owner of the field, observing the buzzing swarms of the Red-tailed Tachina-fly, assumed that the fly was the parent of the worms, and as the former

was an active, winged creature, capable of extended flight, he concluded that remedial work was useless, since the flies could, and doubtless would, deposit their eggs over the entire surrounding country. As a consequence the worms were allowed to travel to the adjoining fields and the injury thus increased through ignorance of the fact that the Tachina flies were the most important of the parasitic enemies of the worm. For many years well-informed gardeners in parts of Europe have practiced collecting ladybirds and some of the ground beetles to liberate upon plants infested by plant-lice or by cutworms. The characteristics of these two families, Coccinellidæ and Carabidæ, should be taught in our schools, as a definite knowledge of certain species, which is readily acquired, may often be turned to account in a limited way by the cultivator.

In a few cases like this there is no reason why the farmer should not be taught with advantage to discriminate between his friends and his foes, and to encourage the multiplication of the former; but for the most part the nicer discriminations as to the beneficial species, some of the most important of which are microscopically small, must be left to the trained entomologist. Few of the men practically engaged in agriculture and horticulture can follow the more or less technical characterizations of these beneficial species, and where the discriminating knowledge is possessed it can, as just intimated, only exceptionally be turned to practical account. Thus our literature on this subject in the past has been of interest from the entomological rather than from the agricultural point of view, as most writers on economic entomology have contented themselves with describing and illustrating such beneficial species.

In other cases much good may be done without any special knowledge of the beneficial forms, but as a result of a knowledge of the special facts which enables the farmer to materially encourage the multiplication of parasitic species while destroying the plant-feeding host.

The Rascal Leaf-crumpler (*Mineola indiginella* Z.), a common insect which disfigures and does much damage to our apple and other fruit trees and which hibernates in cases attached to twigs, is a case in point. Many years ago I urged the importance of preserving the several parasites known to prey upon it, in the following language:*

> The orchardist has but to bear in mind that it (the leaf-crumpler) is single-brooded and that it passes the winter in its case, and he will understand that by collecting and destroying these cases in the dead of the year when the tree is bare, he effectually puts a stop to its increase. * * * Whether collected in winter or pulled off the trees in spring or summer, these cases should always be thrown into some small vessel and deposited in the center of a meadow or field away from any fruit trees. Here the worms will wander about a few yards and soon die from exhaustion and want of food, while such of the parasites, hereafter mentioned, as are developed or in the pupa state will mature and eventually fly off. In this manner, as did Spartacus of old, we swell the ranks of our friends while defeating our foes.

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*Fourth Report, Insects of Missouri, 1871, p. 40.

The practical value of this suggestion was subsequently fully demonstrated, and especially by the late D. B. Wier, who, at a meeting of the Illinois Horticultural Society, as secretary of a committee appointed by said society to consider the best means of securing coöperation in the warfare against the fruit-growers' insect enemies, announced that this policy had been followed with happy results.

A similar course was urged by me in the case of our common Bagworm (*Thyridopteryx ephemeræformis*). This species, as we know, is also subject to parasites, and the bags or cases which are collected in winter, instead of being burned, should be allowed to remain until the middle of the next summer in some vessel well separated from trees and shrubs, in order that the young worms, when they hatch in spring from the eggs contained in the female bag, may perish, while the parasites develop and escape. Prof. J. H. Comstock has suggested in a similar way the placing of the hand-collected chrysalides of the imported Cabbage Worm (*Pieris rapæ*) in boxes covered with wire netting, in order to admit of the ready escape of the little Chalcid parasite (*Pteromalus puparum*) and at the same time retain such of the butterflies as may issue—a practice which had, I believe, been successfully employed in Europe. Other similar cases of this mode of encouragement will occur to you, but, as already stated, with comparatively few exceptions, such as those indicated, the multiplication of our parasitic and predaceous species on the line of the first method is practically beyond our control.

It is quite different in the second method of dealing with beneficial insects, for here man has an opportunity of doing some very effective work, and it is only within comparatively recent years that the importance of this particular phase of the subject has been fully realized. The Rev. C. J. S. Bethune, of Canada, was probably the first entomologist to suggest, in one of the earlier volumes of the *Canadian Farmer*, the importation of the European parasites of the Wheat Midge (*Diplosis tritici*) into America, on the supposition that this cosmopolitan species might thus be kept in check on this continent to the same extent that it was in Europe. So far as I am aware, the attempt was never actually made, and though some subsequent correspondence was entered into between Fitch and Curtis, and later between Walsh and some of his English friends, nothing tangible resulted. The matter was, in fact, never seriously studied with this purpose in view.

The importance of this phase of the subject was early forced upon my attention, as it was upon that of others, and is frequently referred to in my earlier writings. Thus, in 1869–'70, in studying the parasites of the Plum Curculio, it became evident that they were of such a nature that they could easily be transported from one locality to another, and I distributed from Kirkwood, Mo., *Sigalphus curculionis* Fitch and *Porizon conotracheli* Riley to several correspondents in other parts of the State. I also urged a similar course with regard to some of the parasites of the Coccidæ, which it happens may be easily transported from

one place to another in their undeveloped or adolescent stages.* Le Baron, in his studies of the Oyster-shell Bark-Louse of the Apple and one of its parasites (*Aphelinus mytilaspidis*), transported scale-covered twigs during winter from Geneva, Ill., to Galena, Ill., with beneficial results. The experiment was conducted on a small scale, but the parasites issued and became domiciled in their new locality, thus proving the practicability of his scheme. In neither my own experiments nor in Le Baron's, however, was sufficiently thorough examination made to prove that the parasites did not already exist in the localities in which they were colonized.

Planchon and myself introduced *Tyroglyphus phylloxeræ* from America into France in 1873,† and it became fully established, as subsequent correspondence and observation showed. In 1874 efforts were made to send over from England to New Zealand certain Aphid parasites to check the alarming increase of those plant pests there, and while I have no records at hand to show with what success, the later successful introduction of bumblebees to the latter country to fertilize the red clover is well-known history. In his report upon the parasites of Coccidæ in the Annual Report of the Department of Agriculture for 1880, Mr. Howard gave the subject some theoretical attention and elaborated upon the ease with which Coccid parasites could be transported from one part of the country to another during winter. He suggested the experiment of transporting *Dilophogaster californica* from the Pacific coast to certain of the Southeastern States, where it might be expected to prey upon certain large species of Lecanium. In 1883, after previous futile attempts by myself and Mr. Otto Lugger, and with the assistance of G. C. Bignell, esq., of Plymouth, England, the living cocoons of *Microgaster glomeratus*, a common European parasite of *Pieris rapæ*, were successfully imported by the Department and the colonization of the species was established, not only in the District of Columbia, but in Iowa, Nebraska, and Missouri, as specimens were simultaneously sent to the agents of the Division in those States.‡ It has become so widely distributed since then as to lead to the inference that it must have been previously introduced at some other points, though the spread of an introduced species, even when introduced at a single point, is often so rapid that it surprises us, especially of a species that is winged, as evidenced by the spread of the Horn Fly (*Hæmatobia serrata*) over the whole eastern United States in about four years. Later, in 1891, with the aid of Mr. Fred. Enock, of London, a successful effort was made to introduce into this country from England an important Chalcid parasite of the Hessian Fly, *Entedon epigonus* Walker (*Semiotellus nigripes* Lind.). The details of this experiment will be

*Third Rep., Ins. Mo., 1870, p. 29; Fifth Rep., do., 1873, p. 90.

†Sixth Report, Ins. Mo., 1874, p. 55.

‡Report of the Etomologist in Rep. U. S. Dept. Agric. for 1884, p. 323.

found in my published writings, especially in my report as U. S. Entomologist for 1891, and it is only necessary to state at this time that parasitized puparia of the Hessian Fly were received in large numbers and distributed to various points, and placed in the care of competent observers in Illinois, Indiana, Michigan, and Canada. The results so far have not been marked, and but one positive report as to the acclimation of the parasite has been received, viz, from Prof. S. A. Forbes, of Champaign, Ill. I am of the opinion, however, that the lack of evidence from other points is due almost entirely to lack of proper examination, and I have every hope that the species will before long be found to have obtained a secure foothold at all of the several points of introduction. It is a very difficult matter to ascertain the existence of a parasite of this minute size, except when it occurs in great numbers. It requires an eye trained not only to the examination of these minute creatures, but one familiar with the allied imported species and native species. The reason for attempting the introduction of this particular species was simply that in England it was found to be far more abundant and far more beneficial than any of our native species have so far proved.

The present year I have become interested in the matter of the importation of a predaceous Noctuid (*Erastria scitula*) which preys upon the Black Scale (*Lecanium oleæ*) in south Europe and helps materially to keep it in check. With the help of Prof. H. Rouzaud, of Montpellier, France, who has studied the habits of this insect with extreme care, I hope to establish it in southern California, where the climatic conditions are sufficiently close to those of south Europe, and where the Black Scale does great damage to olive orchards and to oleander trees, and also affects less seriously the Orange and Lemon. The Black Scale has already an important enemy in California in the shape of the Dilophogaster above mentioned, but the latter is only two-brooded, and the scale insect, multiplying more rapidly, outstrips it in the race for maturity. The Erastria, on the contrary, passes through five or six generations in the course of a summer, and, as it is purely predaceous, it will, I believe, prove a most useful auxiliary against the Black Scale, especially if brought over without its parasites.

So far I have spoken only of the insects which have been imported into this country, but some effort has also been made in the opposite direction. Thus we have endeavored (and with some success) to return the service done us by sending to Australia and New Zealand some of our predatory Coleoptera, some of the Pacific coast parasites of the Codling Moth, and a species of the interesting genus Raphidia, which also preys upon the Codling Moth.

In 1887 and 1888 the now well-known importation of *Vedalia cardinalis* from Australia and New Zealand to California, to prey upon *Icerya purchasi*, was successfully carried out. The history of this striking example of the beneficial results that may, in exceptional

cases, flow from intelligent effort in this direction, is now sufficiently well known to American economic entomologists; but anticipating that we shall have foreign delegates among us, and that our proceedings will be published more widely than usual, it will, perhaps, be wise to give the salient historical facts in the case, even at the risk of some repetition of what has been already published. In doing this the indulgence of the society is craved for the prominence of my own part in the work, rendered necessary by the disposition in some quarters to distort the facts.

The Fluted Scale, otherwise known as the White or Cottony-cushion Scale (*Icerya purchasi* Maskell), is one of the largest species of its family (Coccidæ), and up to 1888 had done immense injury to the orange groves and to many other trees and shrubs of Southern California. From Australia, its original home, it had been imported into New Zealand, South Africa, and California, the evidence pointing to its introduction into California about 1868, and, probably, upon *Acacia latifolia*.

In my annual report as U. S. Entomologist for 1886 will be found a full characterization of the species in all its stages; but the three characteristics which most concern the practical man, and which make it one of the most difficult species to contend with, are its ability to survive for long periods without food, to thrive upon a great variety of plants, and to move about throughout most of its life.

The injuries of this insect, notwithstanding the efforts to check it, kept on increasing, and some ten years ago I felt that the work of this particular species and of others which seriously affected the fruit-growing interests of Southern California justified the establishment of agencies there. Up to this time no special entomological effort had been made by the Government on behalf of the fruit-growers of the Pacific coast. Through agents stationed, the one at Los Angeles, the other at Alameda, a course of elaborate experiments was undertaken as to the best means of treating the insects affecting the Orange there, and more particularly this Fluted or Cottony-cushion Scale. During the progress of these investigations, however, the fact impressed itself upon my mind that we had here an excellent opportunity of calling to our aid its own natural enemies, for while there were some doubts as to the origin of Icerya, the question was finally settled to my own satisfaction that it was of Australian origin, and that in its native home it was not a serious pest, but was kept subdued by natural checks. These facts were not positively ascertained without a good deal of correspondence and investigation, involving, in fact, a trip to France, as has been set forth in my published writings upon the subject.

In my report as U. S. Entomologist for 1886, in an address before the State Board of Horticulture at Riverside, California, in 1887; in a paper before the Philosophical Society of Washington in the winter of 1888, and elsewhere, I urged, with all the force at my com-

mand, the advisability of endeavoring to introduce the natural enemies which were known to keep it in check in Australia. Certain indigenous species had been discovered preying upon it in California, and I expressed the belief that, as they increased, the fruit-growers would get more and more relief from the Icerya; but I also urged that there was much more chance of success from those which keep it in check in its native home, and which were not imported with it to the countries of its introduction. The case was exceptional, and the attempt thus urged gave every promise of a rich reward. Efforts were made to introduce some of these natural enemies through correspondence, especially with the late F. S. Crawford, of Adelaide, with what ultimate results the subsequent success of Vedalia forever rendered uncertain.

The Hon. H. H. Markham, present Governor of California, was at that time a Representative in Congress, and through him chiefly, but also through others, I urged upon Congress the desirability of sending some one to Australia to make a thorough study of the subject with a view of introducing those natural enemies. Again, in the winter of 1887–'88 appeals were made to Congress, not only of a personal nature, but through memorials from various societies in California, for an appropriation to send one or two men to Australia to collect and increase these natural enemies. Congress, however, failed to make any specific appropriation, and also failed to remove the restriction in the appropriation to the Division of Entomology which limited traveling expenses to the United States and prevented independent action of the Department of Agriculture. It happened, however, that about this time an appropriation was made and a commission created to represent the United States at the Melbourne Exposition, and, with the appreciative aid and sympathy of the Hon. Norman J. Colman, Commissioner of Agriculture, I took active steps to gain the coöperation of the Secretary of State in my pet scheme, and by an arrangement with the Department of State, accepted by the commissioner to said Exposition, Hon. Frank McCoppin, the Department of Agriculture was finally enabled to send to Australia two agents of the Division of Entomology, one of them to be under my instructions, and the expenses of both, within the sum of $2,000, to be paid out of the appropriation for the aforesaid Exposition.

It was thus that Mr. Albert Koebele, in the fall of 1888, was sent to Australia for this special purpose. The history of Mr. Koebele's efforts has been detailed from time to time in Government publications and in the press, especially that of California. It suffices to state that a number of living enemies, both parasitic and predaceous, were successfully imported, but that one of them, *Vedalia cardinalis*, proved so effective as to throw the others entirely into the shade and render their services really unnecessary. It has, so far, not been known to prey upon any other insect, and it breeds with surprising rapidity, occupying less than thirty days from the laying of the eggs until the adults again appear.

These facts account for its exceptionally rapid work, for in point of fact, within a year and a half of its first introduction, it had practically cleared off the Fluted Scale throughout the infested region. The expressions of two well-known people may be quoted here to illustrate the general verdict. Prof. W. A. Henry, Director of the Wisconsin Agriculture Experiment Station, who visited California in 1889, reported that the work of Vedalia was "the finest illustration possible of the value of the Department to give the people aid in time of distress. And the distress was very great indeed." Mr. William F. Channing, of Pasadena, son of the eminent Unitarian divine, wrote two years later:

> We owe to the Agricultural Department the rescue of our orange culture by the importation of the Australian ladybird, *Vedalia cardinalis.*
>
> The white scales were incrusting our orange trees with a hideous leprosy. They spread with wonderful rapidity and would have made citrus growth on the whole North American continent impossible within a few years. It took the Vedalia, where introduced, only a few weeks absolutely to clean out the white scale. The deliverance was more like a miracle than anything I have ever seen. In the spring of 1889 I had abandoned my young Washington navel orange trees as irrecoverable. Those same trees bore from two to three boxes of oranges apiece at the end of the season (or winter and spring of 1890). The consequence of the deliverance is that many hundreds of thousands of orange trees (navels almost exclusively) have been set out in southern California this last spring.

In other words, the victory over the scale was complete and will practically remain so. The history of the introduction of this pest, its spread for upwards of twenty years, and the discouragement which resulted, the numerous experiments which were made to overcome the insect, and its final reduction to unimportant numbers by means of an apparently insignificant little beetle imported for the purpose from Australia will always remain one of the most interesting stories in the records of practical entomology.

The Vedalia has since been successfully colonized at the Cape of Good Hope and in Egypt, and has produced the same results in each case. In Egypt the Vedalia was introduced to prey upon an allied species of Icerya (*I. ægyptiacum*, Douglas). We hope soon to be able to send the same insect to India, where it has recently transpired that *Icerya ægyptiacum* occurs, while recent information received from Phra Suriya, royal commissioner of Siam at Chicago, would indicate that its introduction into Siam for the same or a closely allied insect will be desirable in the near future.

In fact, the success of the experiment was so striking and so important, and resulted in the saving to California of an industry of so great a money value, that it has given rise, not only in the popular mind but in the minds of a certain class of entomologists also, to the idea that remedial work against injurious insects should be concentrated upon this one line of action, and that our best hope for their destruction lies with the parasitic and predaceous species, not to mention fungus and bacterial diseases. From an extreme of comparative incredulity the

farmer and fruit-grower have gone, perhaps, to the other extreme of too great faith. The case of Icerya and Vedalia, as I have frequently pointed out, was exceptional and one which can not easily be repeated.

One of the humorous phases of the Vedalia experiment is, that the wide newspaper circulation of the facts—not always most accurately set forth—has brought me communications from all parts of the world asking for supplies of the renowned little Ladybird for use against injurious insects of every kind and description, the inquiries being made, of course, under a misapprehension of the facts.

While this California experience thus affords one of the most striking illustrations of what may be accomplished under exceptional circumstances by the second method of utilizing beneficial insects, we can hardly expect to succeed in accomplishing much good in this direction without a full knowledge of all the ascertainable facts in the case and a due appreciation of the profounder laws of nature, and particularly of the interrelations of organisms. Year in and year out, with the conditions of life unchanged by man's actions, the relations between the plant-feeder and the predaceous and parasitic species of its own class remain substantially the same, whatever the fluctuations between them for any given year. This is a necessary result in the economy of nature; for the ascendancy of one or the other of the opposing forces involves a corresponding fluctuation on the decreasing side, and there is a necessary relation between the plant-feeder and its enemies, which, normally, must be to the slight advantage of the former and only exceptionally to the great advantage of the latter.

This law is recognized by all close students of nature, and has often been illustrated and insisted upon by entomologists in particular, as the most graphic exemplifications of it occur in insect life, in which fecundity is such that the balance is regained with marvelous rapidity, even after approximate annihilation of any particular species. But it is doubtful whether another equally logical deduction from the prevalence of this law has been sufficiently recognized by us, and this is, that our artificial insecticide methods have little or no effect upon the multiplication of an injurious species, except for the particular occasion which calls them forth, and that occasions often arise when it were wiser to refrain from the use of such insectides and to leave the field to the parasitic and predaceous forms.

It is generally when a particular injurious insect has reached the zenith of its increase and has accomplished its greatest harm that the farmer is led to bestir himself to suppress it, and yet it is equally true that it is just at this time that nature is about to relieve him in striking the balance by checks which are violent and effective in proportion to the exceptional increase of and consequent exceptional injury done by the injurious species. Now the insecticide method of routing this last, under such circumstances, too often involves, also, the destruction of the parasitic and predaceous species, and does more harm than

good. This is particularly true of those of our Coccidæ and Aphididæ and those of our Lepidopterous larvæ which have numerous natural enemies of their own class; and it not only emphasizes the importance of preventive measures, which we are all agreed to urge for other cogent reasons, and which do not to the same extent destroy the parasites, but it affords another explanation of the reason why the fight with insecticides must be kept up year after year, and has little cumulative value.

But the problem of the wise encouragement and employment of the natural enemies of injurious insects in their own class is yet more complicated. The general laws governing the interaction of organisms are such that we can only in very exceptional cases derive benefit by interference with them. The indigenous enemies of an indigenous phytophagous species will, *cæteris paribus*, be better qualified to keep it in check than some newly introduced competitor from a foreign country, and the peculiar circumstances must decide in each case the advisability of the introduction. The multiplication of the foreigner will too often involve the decrease of some indigene. If a certain phytophage is generally disastrous in one section and innocuous in another by virtue of some particular enemy it will be safe to transfer and encourage such enemy, and this is particularly true when the phytophage is a foreigner and has been brought over without the enemy which subdues it in its native home. Icerya had some enemies in California, presumably American, but they were not equal to the task of subduing it. Vedalia, in the Icerya's native home, Australia, was equal to the task and maintained the same superiority over all others when brought to America. The genus was new to the country and the species had exceptionally advantageous attributes. But there is very little to be hoped from the miscellaneous introduction of predaceous or parasitic insects for the suppression of a phytophage which they do not suppress in their native home or in the country from which they are brought.

The results of the introduction by Mr. A. D. Hopkins of *Clerus formicarius* to contend with the Scolytids which were ruining the West Virginia pines were doubtful, for the reason that indigenous species of the genus were already at work in America. Yet the experiment was safe and desirable, because the European Clerus is more active and more seemingly effective than our indigenes. The Gypsy Moth was evidently introduced into Massachusetts without its European natural enemies, and as in some parts of Europe it is often locally checked by such natural enemies, a great number of which are known, a proper study of them and the introduction of the most effective could result in no possible harm and might be productive of lasting good. Such a course was advised by me at a conference upon the subject held in the rooms of the State Board of Agriculture, Boston, March 4, 1891,* and in corre-

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* INSECT LIFE, III, p. 369, ff.

spondence with the Secretary of the Board. In neither of these cases should we expect the predaceous or parasitic forms to subdue their hosts more effectually in America than they do in Europe, except in so far as they were relieved, in the introduction into America, of whatever enemies they possessed in their native home.

There are two other laws which it is worth while to consider in this connection. One is, that while a plant-feeder's natural enemies are apt to cause its excessive abundance to be followed by a corresponding decrease, yet this alternation of excessive abundance and excessive scarcity will often be produced irrespective of such natural checks. An injurious insect which has been on the destructive march for a period of years will often come to a sudden halt, and a period of relative, and sometimes complete, immunity from injury will follow. This may result from climatic conditions, but more often it is a consequence of disease, debility, and want of proper nutrition, which are necessary corollaries of undue multiplication. Frequently, therefore, it may be inaccurate and misleading to attribute the disappearance of a particular injurious species to some parasitic or predaceous species which has been let loose upon it, and nothing but the most accurate observation will determine the truth in such cases. The past year furnished a very graphic illustration in point. Throughout Virginia and West Virginia, where the spruce pines have for some years suffered so severely from the destructive work of *Dendroctonus frontalis*, not a single living specimen of the beetle has been found during the present year. This has been observed by every one who has investigated the subject, and particularly by several correspondents who have written to me; by Mr. E. A. Schwarz, who was commissioned to investigate the facts, and by Mr. Hopkins, who has made the study of the subject a specialty.

The clearest explanation of this sudden change is that the species was practically killed out by the exceptionally severe cold of last winter, since such was the case with several other insects. Now, following so closely on the introduction by Mr. Hopkins of *Clerus formicarius*, how easy it would have been to attribute the sudden decrease to the work of the introduced Clerus had not the decrease been so general and extensive as absolutely to preclude any such possibility. In like manner a certain Scale Insect (*Aspidiotus tenebricosus*) had become exceedingly destructive to the Soft Maples in the city of Washington last year, whereas the present year it is almost entirely killed off, evidently by the same exceptional cold. Many of the affected trees were painted with whitewash, with a view of destroying the Aspidiotus, and the death of this last might have been attributed to the treatment (and naturally would be by those employing it) were it not that the same result was equally noticeable on the trees not treated. Reports from southern California would indicate that the Red Scale (*Aspidiotus aurantii*) is, in many orchards, losing its destructiveness through agencies other than its insect enemies, and in this case the facts are particularly interesting because of the ease with which

its disappearance may be attributed to some of the recent introductions from Australia.

The other law that is worth considering in this connection is that experience has shown that, as a rule, the animals and plants of what is known as the "Old" World—*i. e.*, of Europe and Asia—when introduced into North America have shown a greater power of multiplication than the indigenous species, and in a large number of instances have taken the place of the native forms, which have not been able to compete with them in the struggle for existence. The converse proposition holds equally true, viz: that our species when taken to Europe do not hold their own against the European indegenes. This is still more true of the species introduced from the Old World, as well as from America, into Australia, where the advantage of the introduced forms, as compared with the indigenous, has been in many cases still more marked. All other things being equal, therefore, we should expect the species which are beneficial in Australia to be less so when brought to this country, a deduction which brings out still more clearly the exceptional nature of the case of Vedalia and Icerya, just as there are some notable exceptions, as in the case of the Grape Phylloxera, in the introductions between Europe and America.

There are some instances in which there can be no doubt whatever as to the good which would flow from the introduction of beneficial species, and an illustration is afforded in the Capri-fig insect, *Blastophaga psenes.* There can be no question as to the good which would result from the introduction of this species from Smyrna into those sections of California where the Smyrna fig is grown without its intervention, and there are other similar instances which promise well and involve no risk. But I have said enough to show that the successful utilization of beneficial insects is by no means a simple matter and that discriminating knowledge is required to insure success or prevent disaster, especially in the second category dealt with in this paper. The danger attending introductions of beneficial species by unconsciously accompanying them with injurious forms, or by failure to appreciate the facts here set forth, is well illustrated by the introduction to Europe of our *Peronospora viticola*, of the English Sparrow to America, and of the Mongoose to Jamaica. Wherever the importance of the matter leads to legislation, what are denominated "political" methods are apt either to control or in some way influence the resulting efforts—too often with unfortunate consequences. We should, as economic entomologists, be on the alert for special cases where the introduction or dissemination of beneficial species promises good results, and do our best to encourage an intelligent public appreciation of such special cases, while discouraging all that is of a sensational nature, as likely to mislead and ultimately do our profession more harm than good.

The paper was discussed by several members.

THE ECONOMIC VALUE OF PARASITES AND PREDACEOUS INSECTS.

By JOHN B. SMITH, Sc. D., *New Brunswick, N. J.*

At the very outset I wish to disclaim all intention either of producing a treatise on parasitism in general or disputing the importance of parasites in nature. No one can realize more than I do how much parasites maintain the balance and check the increase of injurious species. I am perfectly aware that were it not for parasites many an insect would become so abundant that certain crops could not be satisfactorily grown. Fully realizing, therefore, the place and importance of these parasites I feel at the same time that their economic value has been grossly overestimated; in fact I am almost ready to say that parasites have no real economic value to the agriculturist. This sounds like a very radical statement, and perhaps I do not mean it in the fullest sense of the terms that I have used; but I would not much modify the sense of the language. The "life history" of an insect is incomplete until we know not only how it lives and upon what it feeds, how it transforms, and the duration of its various stages, but also what species prey upon it, and to which it furnishes sustenance in one or the other of its stages. We are therefore right in our studies of the "life history" of injurious insects in studying also the parasites that prey upon them. We are right also in publishing the results of our work, including the descriptions of the parasites. We are right in calling the attention of the farmer to the fact that the injurious species are very largely kept in check by either parasites or by predaceous insects; but we are wrong in leading him to suppose that either parasites or predaceous insects will control the injurious species for him. Yet the tendency of the language used in many cases by entomologists, and more often by those who are not entomologists, has suggested the possibility that injurious species may be controlled by either parasites or natural enemies without very much work on the part of the farmer. The impression is current that it will be possible to use natural means to exterminate injurious insects, and I have been asked frequently during the past two years, by farmers that may be considered as fully equal in intelligence to the best in the land, those who read and usually understand, why I did not make some effort to cultivate or import parasites or natural enemies of our common injurious insects. Of course these questions all grow out of the remarkably successful experiment made by Dr. Riley in the importation of the Australian *Vedalia cardinalis* to exterminate the imported *Icerya purchasi*, and I have decided to bring up this subject for discussion at the present meeting in order that possibly a little more definite light can be obtained upon the exact place of parasites and predaceous insects in economic entomology. It needs no argument on my part to prove that nature

never creates organisms merely to destroy others that she had previously created. Parasites do not exterminate their hosts in any instance; their mission is merely to interpose a check to undue increase, and it is natural that this should be so, for were the host destroyed the parasite itself would perish, unless it were able to change its food and prey upon other species. It is by no means improbable that in the past certain species have been exterminated by their parasites, and, indeed, it is very probable that some such cases are in progress now. Many lepidopterous larvæ are rarely found free from parasites, and the adults are among the rarest of our species. Here we have instances where the parasite very materially lessens the number of the host and allows each year only a very few specimens to escape. It is only through the fecundity of the specie that it is enabled to maintain itself at all. These cases are exceptional. Usually the relation of the parasite to its host is more moderate. Excessive increase is checked, but excessive increase only. There is always a very large proportion of larvæ and usually a comparatively small proportion of parasites. Nature tends to preserve a balance among her creatures, and a balance only. Many species which are much subject to parasites are abundant each year, and remain equally abundant from year to year, varying only very slightly; and these variations are rarely the result of an excessive increase of parasites. Nature also works very slowly, and she adapts insects as well as other animals to their environment only by means that require ages for their completion. Insects that are confined to plants which, under natural conditions are not common, need few parasites to keep them in check. The great difficulty in finding food is in itself a sufficient check, and parasites are not necessary; indeed they could not be supported under the circumstances. If, by any unnatural condition introduced by man, the supply of food for this otherwise rare insect is suddenly increased, it obtains the possibility of multiplying rapidly, while the number of parasites does not increase proportionally. In the course of time nature may make a change and other species may attack this form which has now increased abnormally; but this is something that the farmer can not wait for; he must have some means of dealing with the insect at once, and he must leave the operations of nature to benefit his descendants. The spread and increase of the potato beetle, *Doryphora 10-lineata*, is a case in point. Here neither parasites nor natural enemies assist the farmer in any noticeable way. He must depend upon his own exertions to save his crop. There are, however, many insects which are very commonly parasitized, and among them may be mentioned the various species of cutworms. It is nothing uncommon to find in an infested field that fully one-half, and sometimes as many as three-quarters, of the specimens will have eggs of the Tachina flies attached to the skin and, probably, others have parasites which are not externally visible. Yet the fact that these cutworms are infested by para-

sites is of absolutely no value to the farmer. They eat just as much as if they were not parasitized, and it is really a matter of little importance to the agriculturist whether the food that is stolen from him makes a moth or a fly. The caterpillar feeds all the same until it is full grown. Next year in the same field there will be just as many cutworms as there were in the previous year. The parasites have kept the number within the same limit, and the farmer has not been benefited. If he desires to save his crop he must himself adopt measures for the destruction of these insects; parasites will not help him in the least. Let us take another instance: One of the species of Tortricids infesting the Cranberries is very subject to the attacks of parasites, two species being abundant, and a third rare; yet every year the bogs suffer equally from this species. If we collect a large lot of larvæ in the early spring we will find that very few of them will give out parasites. From the second brood we will breed a great many more, while of the third and last brood, probably 75 per cent will prove to be infested by parasites. This sounds very pretty, indeed, and we say that the insect has been controlled by its parasites, and so it has; but not until it has ravaged the bogs, and has done all the injury that it could do. It has destroyed the crop, and, seeing the enormous increase of the parasites during the year, the natural conclusion is, that they will next spring still further reduce the number of their host and bring matters to such a state that little or no further injury is to be apprehended. Yet, as a matter of fact, nothing of the kind occurs. We find that somehow during the winter the mortality among the parasites has been very much greater than it has been among the moths, and that just as in the previous year the first brood of moths will be almost exempt from the attacks of parasites. We will have on the bogs exactly the same history that we found in the previous year. Of what practical benefit is this parasite to the farmer? It does not do anything in the world to prevent the destruction of his crop, nor does it in any way lessen the damage, for where these insects occur and are allowed to increase without check, except by their natural enemies, they appear in sufficient numbers each year to take the entire crop. This is not a solitary instance. It can be matched with ease in all our common insects. The Codling Moth, for instance, has parasites, and is doubtlessly kept in some check by them; yet every one present knows that if parasites and natural enemies alone were depended upon, farmers could not count on a single perfect apple. They do check the excessive increase of the insect, but they do not lessen in the least the number that can be supported by the food plants. All the parasites that have been described from the Codling Moth, from the Plum Curculio, and any others of our injurious insects do not benefit the farmer one dollar in the value of his crops, and I think it is well that this should be generally understood, because of the tendency that I have already mentioned to expect too much from the parasites. It must be remembered also that in the opera-

tion of preserving the proper balance between life of all descriptions, nature itself has intervened to prevent the undue increase of the parasites, either by making them less fertile than the hosts upon which they prey, by giving them a smaller number of broods, or by supplying them in turn with parasites which keep them in check. This secondary parasitism is well known and it is as effective in preventing the excessive increase of the primary parasites as these are in preventing the excessive increase of the original host. There is really almost as much danger, and that is very little, that the secondary parasites will destroy the primary parasite as that the primaries will exterminate their host. Predaceous insects are in much the same case, they never entirely destroy the species they feed upon, and in 99 cases out of 100 they conquer their prey after all the injury has been done to the growing crops. Let us take the case of the Melon Louse for example. This makes its appearance in June or July, and increases with marvelous rapidity. Very soon after various species of Coccinellids make their appearance and begin preying upon the plant louse; but in the number in which they first appear they are incapable of eating up the lice as fast as they multiply. By September they are up with their prey, but then it is too late; the crop has been destroyed and, although it is quite probable that the late broods have entirely rid the vines of plant lice, yet it has not benefited the farmer one solitary cent. I had a beautiful opportunity of observing just this in 1892. It was a pleasure to see how the late broods moved from vine to vine, leaving scarcely a living louse behind them; but that same vine was dried and withered; whatever fruit there remained on it was undersized, blackened by honey-dew, half ripe, and never in fit condition for market. Acre after acre I have seen in just that condition, and practically no revenue has been derived from the land. It is quite true that the beetles exterminated or nearly exterminated the plant lice, but this did not advantage the farmer one solitary cent. A few buckets of kerosene emulsion liberally applied early in the season, while the plant lice were running away from the lady-birds, would have been of a great deal more money benefit than all the aid that nature gave. My contention is, that in dealing with injurious insects from the farmer's standpoint, we can entirely ignore the work of parasites or predaceous insects. We must accept the fact that each year these insects will appear in about the same numbers; that nature has evidently assumed that this is about the proper number to appear, and that all her checks are arranged accordingly. If we wish to lessen them, we must do it by means other than those which she has provided.

There is, of course, a possibility that we may in some cases make use of either parasites or predaceous insects. That has been very well illustrated by the instance before referred to, that of the Vedalia and the Icerya. The one point that is overlooked by the majority of those who see only newspaper accounts is, that we had to deal in the first

place with an insect which was not a native, but which was imported. In the second place the insect preying upon it was also imported, and found as the only familiar form upon which it has been used to feed just this one species. In bringing over the Vedalia its natural checks were not brought with it, and in liberating it in the orange groves of California it was given an advantage that it could never have possessed in its own country. There may be a few of our insects in a somewhat similar position, and possibly some one of us may yet be as successful as Dr. Riley was in reference to some other permanently injurious species. It may even be that parasites which in their native home are not able to control or exterminate the species upon which they prey may, when introduced into this country, have such an advantage that they will accomplish more than they could in their native home. I say this may be so, but I do not anticipate it in many cases. Insects are very slow to change their habits. Just as it is rare for an American parasite to attack an imported insect in any numbers, just so rarely will we be able to induce a European or other foreign parasite to attack the American insects. We have a field here which is comparatively new, and of which we know very little, but it is not that particular field that it is my intention to enter. The propositions that I do make, and that I am ready to defend are: Among our native insects parasites act merely as a check to excessive increase. Excessive increase means more than the natural food of the insect is able to support, and does not mean excessive increase in the sense of the farmer. An insect that is, under natural conditions, abundant each year must be dealt with without any regard to parasites or natural enemies. Other than I have just suggested, parasites and predaceous insects have absolutely no economic value.

The paper was discussed by several members.

The following paper was next read:

INSECT FOES OF AMERICAN CEREAL GRAINS, WITH MEASURES FOR THEIR PREVENTION OR DESTRUCTION.

By F. M. Webster, *Wooster, Ohio.*

The three principal cereal grains of America north of Mexico, viz, maize, wheat, and oats, cover an approximate area of from 140,000,000 to 150,000,000 acres. In other words, the natural flora over this vast territory, comprising a great variety of species, has been largely exterminated, and, instead, but three have been substituted, all of which are annuals with a capacity for reproducing each year from twenty to two thousand fold. As nature is said to abhor a vacuum, so does she resent a monopoly, except it be in cases where but few species can exist, and the increase of the individuals of these are ultimately restricted by

other influences, such as a rigorous climate or a barren soil. Our grain fields include neither the barren desert, the frozen mountain tops, nor the ice-clad regions of the far North, but the fertile prairies and valleys over which vegetation naturally grows in great luxuriance and profusion, each species if left to itself being kept in its proper numerical sphere by natural laws. The agriculturist, however, comes upon the scene and incites an insurrection, causing the three species before mentioned to not only rebel, but overrun and take possession of these broad acres, putting the original inhabitants to death and estab-

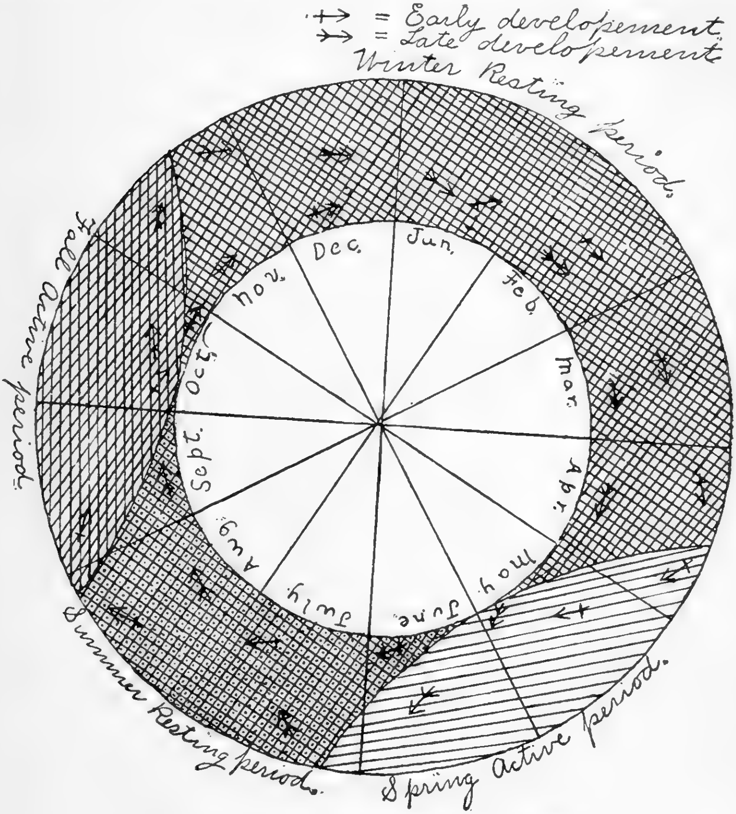


FIG. 2.—The annual cycle of the Hessian Fly (Webster del.).

lishing themselves in nearly or quite full power. If the contest were wholly a natural one, the interlopers would soon be forced into their proper places, and exist only in proportion as they could resist the returning encroachments of the natural flora. But the plow and the hoe again interpose, and the victors still hold the field. Nature then does what is naught but good generalship, brings up her reserves in the animal and vegetable enemies of the three usurping species and precipitates them upon the foe. It is here that the hand of the husbandman seems to lose its cunning. He can fight the forests, the

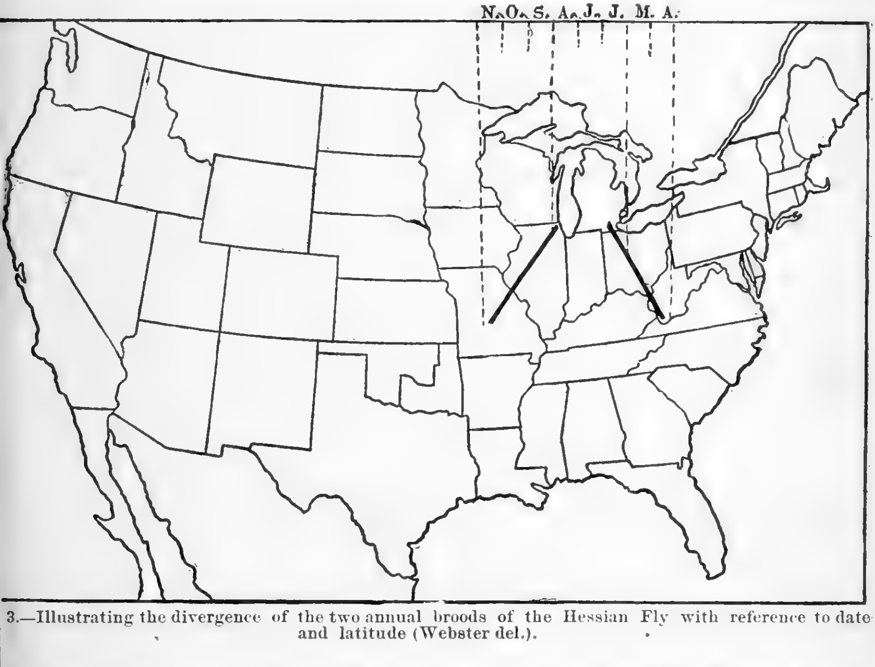
weeds, and the grasses, but when it comes to warring upon the insect and fungoid enemies of his grains he seems to lose heart. His reserve force is, or at least should be, in his superior knowledge; but too often this virtue seems to be either sadly aborted or entirely wanting. He does not study ways to destroy or circumvent these enemies of his crops, but, on the whole, allows them to go their way, patiently taking what they leave and hoping for better luck another year.

It is here that I wish to take up my subject and show how many of the insect foes may be either destroyed or prevented from inflicting serious injury. The field of applied entomology is not the science of killing insects, alone, but includes also the warding off of their attacks. For my own part I would reverse these terms, as it seems to me that the evasion of an attack is ordinarily the most important. I would put it in this way: Warding off the attacks of injurious species by preventing their breeding, and, in case this is not practical, destroying them either before or after the attack had begun. And I may be allowed to here make use of an oft-quoted adage, "An ounce of prevention is better than a pound of cure."

There are upwards of 140 species of insects affecting these three grain crops, and maize alone has over 100 insect foes, a number of course depredating alike upon all three. Of these, such as infest the stored grain excepted, there are very few whose attacks can not be far more easily warded off than remedied after they have begun. I know of no better insecticide than good farming. After eight years of study of the Hessian Fly (*Cecidomyia destructor*), I am satisfied that four-fifths of its injuries may be prevented by a better system of agriculture. For years I have seen wheat grown on one side of a division fence without the loss of a bushel by attack of this pest, while on the other side the crop was almost invariably more or less injured. No effect of climate, meteorological conditions, or natural enemies could have brought about such a contrast of results. The whole secret was in the management of the soil and the seeding. In fact, the question of success in evading the pest, in the one case, did not appear to be an entomological one at all; and I am fully convinced that the Hessian fly problem, so far as it relates to agriculture, throughout that portion of the country lying between the Alleghany Mountains and the Mississippi River, and between the Ohio River and the Great Lakes, may be considered practically solved. As applicable to this area, I have attempted to illustrate in Fig. 2, and also in Fig. 3, ideographically, the annual cycle of this insect, which can of course be only approximately correct for any single locality, there being a variation of nearly if not quite one month in the season of development between the northern and southern boundaries. It will be observed that there are four seasons in this cycle, two of activity and two of inactivity, or, we might term the latter resting seasons. Over this area the winter resting season is by far the longer, while the two active seasons are about equal. Toward the south I

believe the winter season will be found to be shorter and the summer season lengthened until they become equal, while to the north I confidently look for the autumn season of activity to wholly disappear and the species found to be single brooded. (See Fig. 3.)

Heretofore we have told people that the fly could not exist except where fall wheat was grown. But this can be said no longer, as the pest occurs in North Dakota and in a locality where fall wheat is never sown. As the fall brood of flies emerges continually earlier as we go northward, it seems to me that we must eventually reach a point where it will cease to appear in autumn at all, and go over until spring, a state of affairs that will easily account for the breeding in spring wheat



3.—Illustrating the divergence of the two annual broods of the Hessian Fly with reference to date and latitude (Webster del.).

n North Dakota. In other words, I expect to find that nature has protected the species alike from the protracted northern winter, and the equally prolonged southern summer, by varying its resting season with the latitude, and, possibly, also with its proximity to the seacoast. That is, we shall find the insect passing both the hot and cold seasons largely in the flaxseed stage, that being the stage of development during which it is best protected from the elements and lack of food.

There are several good reasons why we might expect the fall brood to become extinct to the north, while the spring brood continues, the principal one being that there is not sufficient time for the former to develop before the cold season begins. Besides, in the continuity of the species it can best be spared, and I understand it is not present in England. In nearly all cases where a species is two-brooded, the spring-

appearing brood of adults is the producing while the fall is the diffusing brood. The spring-appearing flies are loth to leave the field in which they originated, and prefer to oviposit on the tillers of the wheat plant, while the autumn-appearing adults will spread out everywhere over the country, and will, seemingly, scent out a field of wheat at long distances. They can even be drawn to very small plots in the midst of large cities. With the Aphides the winged female produces fewer young, but spreads them over a larger area. In *Isosoma tritici* the spring brood of females has so far followed this rule in the past that their wings are either entirely absent or aborted, while the summer brood, *grande*, has invariably fully developed wings, and is the diffusing brood. The Army Worm, *Leucania unipuncta*, is destructive through one brood only, the fall brood being far less gregarious. This is also true of the Chinch Bug, *Blissus leucopterus*, though in northern Indiana and northern Ohio I find the larger part of the adults with aborted wings. The spring brood of Hessian Fly, coming as it does from plants that will continue through a sufficient season for their progeny to develop, has no need to migrate, while those that summer in the stubble must necessarily change, as the plants can furnish no further nourishment; besides, diffusion and differentiation serve, in a measure, to protect from natural enemies. But notwithstanding this, it will be easily observed that the later brood can be best dispensed with without material and permanent injury to the species. This appears to me to be a state of affairs that we may look for. I do not wish to be understood as making the unqualified statement that these conditions do exist, and only hope that members of this association, located to the north and to the south of the area indicated, will be able to prove either the truth or fallacy of my position We have much yet to learn in regard to this Hessian fly, and a study o it in any locality would probably develop some new features, or at least new parasites.

There are some facts connected with the two species of Isosoma, *I. tritici* and *I. hordei*, that, to me at least, are rather puzzling. Unless an undetermined species, found in New York by Dr. Lintner, proves to be *tritici*, I am not aware of its occurring east of the Alleghany Mountains, though it reaches west to the Pacific coast. On the other hand I never saw *hordei* in Illinois or Indiana, nor did I find them in central Ohio, yet I had not been a week in the northern part of the latter State before I found them in abundance. They occur, generally over the north portion of the State and into Michigan. Is it not possible that *hordei* is of northern origin, where the season is too short fo two broods, while *tritici* has pushed up from the south, where the protracted vernal season is favorable for the development of two broods I find that *hordei* almost invariably selects small wheat plants in which to oviposit, while the summer brood of *tritici* as invariably selects large thrifty stalks, usually where the plants are thin on the ground bu

rank growing. In northern Ohio I never find *hordei* far below the upper joint, an exceptional feature I believe, though it seems to me we might look for such a state of affairs, as it oviposits during a season intervening between the spring and summer broods of *tritici*. Then, too, I notice the parasites of *hordei*, at least *Eupelmus allynii* French, *Semiotellus chalcidiphagus* Walsh, and *Websterellus tritici* Ashmead, emerge in August and oviposit in the same straws from which they themselves emerged, the adults from these emerging in spring. I have also noted the same thing in the two former species where their host was the Hessian Fly. In both instances, however, I got fewer parasites in spring than in August.

So far as measures for their control are concerned, *tritici* can be largely overcome by a rotation of crop, while both this and *hordei* will be destroyed by burning the stubble, a measure equally applicable to the Hessian Fly and Wheat Stem-maggot, *Meromyza americana*. In

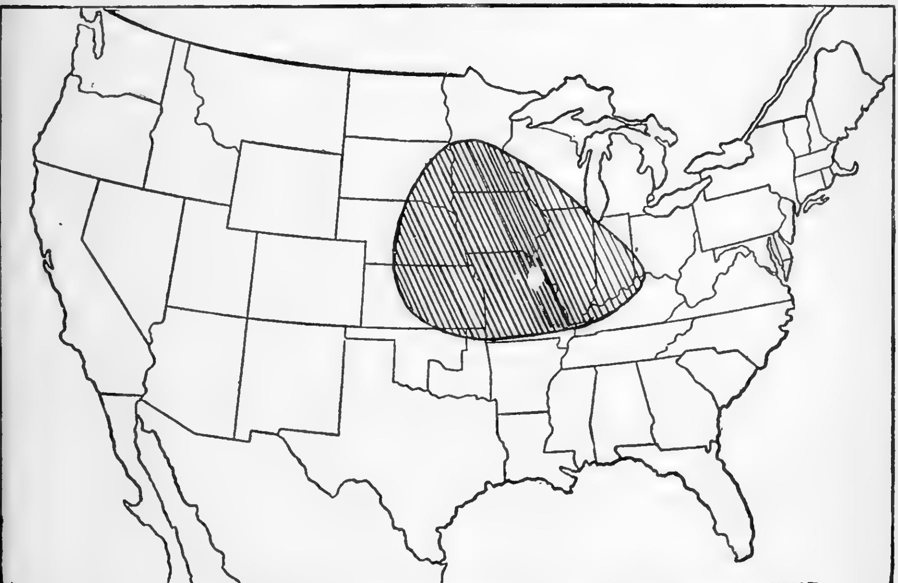


FIG. 4.—Showing area of continued serious ravages by Chinch Bugs. (Webster del.)

some portions of the country, however, clover is sown among the young wheat in early spring, and a burning over in summer under such conditions is impracticable.

I wish to call attention to a few points in reference to the Chinch Bug, *Blissus leucopterus*. The area of extreme continued injury by this pest covers southern Minnesota, southeast South Dakota, much of Nebraska and Kansas, all of Iowa, and much of Missouri, Illinois, all of Indiana except northeastern portion, extreme southwest Ohio, and northern Kentucky (Fig. 4), though in the wheat region of the Mississippi Valley the pest is by no means limited to this area, nor does it confine itself to the wheat region at all.

They are more abundant in Louisiana, where wheat is never cultivated, than they are in northern Ohio, where this cereal is one-half of the grain crop. When they were working their greatest havoc in southern and central Illinois and southwest Indiana I looked in vain for them in northern Indiana. I do not understand why it is that a very large per cent of the adults found in Ohio, along Lake Erie, and in northern Indiana possess only aborted wings; yet I have found this to be the case. As you all know, the insect parasites of this species are very few and of little account in holding it in check. For aid in this direction we must look to meteorological conditions unfavorable to their increase and the fungoid and bacterial parasites. These last will be found available during some seasons and within a certain limit, but nature is not likely to use one of her servants to annihilate another. We may be able to emphasize their work in this direction by continual artificial cultivation and distribution; further than this we can not expect to go, and the relief will at best be but local and temporary, though not by any means without value in limited areas. The only difficulty is in that we, with certainty, can not foretell a year of destructive abundance, and a few false alarms will so discourage the ordinary farmer that he will do nothing to protect himself. For my own part I feel quite sure that if the bugs can be induced to oviposit in spring in small plots of Millet or Hungarian grass they can be controlled by the use of these vegetal diseases to far better purpose than to attempt to do so in the fields of ordinary cultivation. But there must be, somewhere, a central source of supply where requests for material can be promptly filled, as has been done by Prof. Snow, before the plan will prove a success. Next in value to such plats is, I think, the cornfields where the young bugs must of necessity congregate in compact masses and thus facilitate contagion.

It would appear almost visionary to advocate spraying apple orchards in midwinter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the Apple during the winter season. I refer to the Apple Leaf-louse, *Aphis mali* Fab. Soon after the young wheat plants appear in the fall the winged viviparous females of this species flock to the fields and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from the young plants. On very fertile soils this extraction of the sap from the roots has no very serious effect, but where the soil is not rich, and especially if the weather is dry, this constant drain of vitality soon begins to tell on the plants. Though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the Aphis abandons them in autumn to return to the Apple, do they show any amount of vigor. It is very seldom that the affected plants fully recover, at least in autumn, and the result must be to reduce their productiveness the following year.

The greater number of serious pests of our fields of Indian corn are

such as work their injury below the surface of the ground. The larvæ of Elaters devastate our lowlands and the grubs of Lachnosterna ravage the higher lands, while Cutworms, Web Worms, and Corn Root-worms are found generally diffused over both. The Corn-Root-worm, *Diabrotica longicornis*, excepted, all of these seem more destructive to a crop of grain following a grass crop or pasture. Yet this is not always true. I have known of fields of corn being seriously affected by white grubs when such fields had not been devoted to grass for a single season in twenty years.

In the case of Wire Worms some good results may be secured by fall plowing, though as the adults emerge in August or September and winter over, also in this stage, we can hope to do little with these. There are, however, during the winter two younger generations in the soil, and against these a fall plowing may and evidently does have an ill effect. What a summer fallow would do I have had no opportunity of learning. There are no end of reported successes and failures among farmers, but there is so much obscurity shrouding these that one can not judge of their authenticity. Once, and once only, have I felt quite sure of having beaten these pests. This was in the case of a field of grass land, plowed in spring and planted with potatoes. The worms nearly ruined the crop, and in the fall the ground was still well populated with them. The following spring, potatoes that had escaped notice when the crop was harvested seemed to attract the worms, and the latter were found burrowing in the tubers in great numbers. On my suggestion, hogs were turned into the field, and these rooted out and promptly disposed of both potatoes and worms, no injury occurring to the following crop, which was of corn. There may be some virtue in the application of kainit, although this has not as yet been thoroughly and clearly demonstrated, and, besides, over the vast corn belt of the Northwest, its application is impracticable. For myself, I am willing to confess ignorance of any unfailing, practical measure, either of prevention or destruction. Fall plowing and a rapid rotation of crops are as yet the best measures we can recommend.

White Grubs, the larvæ of several of our species of Lachnosterna, appear to give preference to the higher lands. Where the soil of such lands is of such a nature as to wash easily during winter and spring, fall plowing results in the washing out of great gullies, thus constituting a grave objection to the measure. Outbreaks of this pest seem to be usually of triennial occurrence, different localities being affected during different years, and I have thought we might accomplish something by mapping out these areas, and so warn the agriculturist of their probable appearance. Here, however, the same trouble awaits us. A single mistaken prediction discourages the few who will follow our direction, and we get only derision from the remainder. In my own correspondence I have advocated the same measures against these as in case of the Wire Worms, viz, a rapid rotation of crops, especially of

grass or clover, and fall plowing, whenever it can be done without detriment to the fields. What has, or is likely to be accomplished by the use of fungoid parasites, I do not know. The opinion of our presiding officer, who is experimenting in that direction, will be of interest to us all. As in the case of the Corn Root-louse, *Aphis maidis* Fitch, or *Aphis maidi-radicis* Forbes, less injury is done in fields that have been fertilized with barnyard manure.

The Corn Root-worm, *Diabrotica longicornis* Say, has by its ravages cost the farmers of the Mississippi Valley millions of dollars during the last fifteen years, every penny of which might have been saved by a judicious system of husbandry. Every member of this association, located in the infested area, has again and again sounded the alarm and announced the remedy, yet I fear there are some who have not heard it. In Ohio it is unknown, except along the western border of the State. Its occurrence here, where it was reported last year for the first time, raises the question of its eastward diffusion—a problem which I hope to be able to solve. The congenor of this species, the Southern Corn Root worm, *Diabrotica 12-punctata* Oliv., will certainly not be managed so easily. There is yet some investigation to be done on this species, before we can confidently advise in regard to its destruction. It appears, in the adult stage, to be well-nigh omnivorous, and the larvæ travel freely.

The Corn or Boll Worm *Heliothis armiger* Hbn., is more especially a Southern species, though as far north as Chicago, there are during some seasons two broods, as, in that portion of Illinois, I have found half grown larvæ in the ears of ripe corn, in November. In the North the damage done is trivial, often being due to the rain and dew running into the affected ears, causing them to decay. Among the market gardeners, where it works in the sweet corn, the measure suggested by Prof. French, several years ago, which was late plowing in the fall, will do much to hold the species in check. In the South the most sensible and practical suggestion that I have seen mentioned is to plant corn early among the cotton in order to attract the early brood of worms, and then destroy the corn in a way to kill the depredators.

For the major portion of the cutworms, I have much faith in laying down of poisoned grass or clover baits, but the larvæ of *Hadena devastatrix* Brace and H. *stipata* Morris, can not be reached in this manner, as they do not come to the surface to feed. The first eats the plants directly off a short distance above the roots, while the last eats into the stem at about the same place, then tunnels its way upward, eating out the heart after the manner of the Stalk Borer, *Hydrœcia nitela* Gn.

I have here to introduce a third species of Hadena, *H. fractilinea* Grt., and an entirely new depredator in our cornfields, at least so far as published records are concerned. In fact we rarely find the species mentioned at all in our entomological literature. The imago was described in the *Canadian Entomologist* (vol. VI, p. 15, January, 1874),

the habitat there being given as Canada (Pettit), Albany, N. Y. (Lintner). Prof. G. H. French, who first determined the species for me, has it from Maine and New York, and Prof. John B. Smith has it from Maine to Ohio, Minnesota to Colorado. How far south it extends I do not know. The adults are so exceedingly quick in movement and secluded in habit that it is not surprising that it should be overlooked. Several specimens of both sexes that were transferred from the cage in which they were reared to another in which grass was growing were not observed afterwards.

The habits of the larvæ are in strange contrast with those of *stipata*, at least in the cornfields, where that species works entirely below ground, entering the stem just above the roots and eating its way upward, while in this species they climb up the plant and eat downward, devouring the whole interior of the stem down to a point where the *stipata* would begin. If the plant be a young one—that is only 2 or 3 inches in height—these larvæ will enter the cylinder formed by the youngest leaf, but if the plant be older and tougher they will eat downward along the edges, as shown in Fig. 5, until the tissue is more tender, when they will enter the stem and work downward. The time of oviposition I am unable to give. Larvæ, from two-thirds to quite full grown, were taken the last of June, when they were said by farmers to be disappearing. From these larvæ imagoes appeared, *in the insectary*, the last days of July and up to the 10th of August. I did not observe them, nor can I learn of their occurrence elsewhere than on spring-plowed grass land, and this either wholly or in part timothy sward. There appeared to be no difference in point of injury between early and late spring plowing. There did not appear to be any disposition on the part of the larvæ to wander about, but if the corn was planted in hills, after finishing one stalk they would abandon it and attack another, and so on until all were destroyed.

Fig. 5.—*Hadena fractilinea*; *a*, lava; *b*, pupa—nat. size. (Webster del.)

Description of the Larva. (Fig. 5, *a*).—Length 26^{mm}; color, yellowish white, two dark, broad, dorsal stripes separated by a narrower light stripe of the general color of the body, the dark stripes extending from the anal segment forward, unbroken,

to the first thoracic where there are one or two narrow sharply defined interruptions, also of the general color of the body and near the anterior margin of each of the thoracic segments, thereby dividing the dark stripes unequally, the anterior portion being little wider than the interruption. Cervical shield honey yellow, uniform in color with the head, but rather lighter than the anal shield. A rather narrower and darker lateral stripe extends from the head to the anal segment, its lower margin being on a line with the spiracles. At the posterior extremity of this lateral stripe, just above and slightly forward of the anal proleg is a round, dark-brown dot from which originates a short, hooked bristle; just beyond this dot and extending around the posterior margin of the anal segment to a corresponding point on the opposite side and just under the slightly projecting anal extremity is a continuous row of four connected dots of the same dark-brown color and each producing a short, curved bristle, all slightly curving upward. The head is small, rather less than the anal segment with the mouth parts well developed and very dark brown in color, being smaller than the first segment in about the same proportion as the anal segment decreases in size from the one that precedes it and the coloration and markings being so nearly alike, it is not an easy matter to distinguish the two at a glance. From the second to the ninth segment there is little variation in the size of the body, it being rather slender until near the time of pupation, when it increases somewhat in size anteriorly.

Description of the Pupa. (Fig. 5, *b.*)—Length 14^{mm}, greatest diameter 4.5^{mm}. There are no teeth or spines except at tip, where, extending from near the dorsal tip of the last segment are two horizontal, short, robust, blunt appendages, parallel, but flanked on each side by a very slender, hooked appendage, exceeding in length the former but of a lighter color. Just beneath these, on the ventral surface, is a short, deep slit, the edges and vicinity of which are very dark brown. The general color does not differ from that of other allied species.

The larvæ, from which all of my adults were reared, were taken from corn plants either in the field, or from plants sent me by my correspondents, and I saw every one of them in transferring them to the breeding cages. All were working in corn in precisely the same manner and there was certainly no noticeable difference in the larvæ. The imagoes, however, were those of two species, as they are now understood, the larger number being the one under consideration, while the remainder were *Hadena misera* Grt. If, therefore, the two species are distinct, then this also must be added to the list of corn-destroying insects, and a further study will be necessary to separate the larvæ, whose depredations appear not to differ. Prof. Smith writes me that he has this last species from Colorado, taken by Bruce, and also from Minnesota, bred by Prof. Lugger. All this, of course, does not disprove the validity of the species, as, if I remember rightly, there is a strong resemblance between the larvæ of *H. fractilinea* and *H. stipata*, as I observed them in corn in Indiana some years ago.

The various species of web worms, larvæ of several species of Crambus, are, of late, working nearly as much damage in our cornfields as are the cutworms, and are even less accessible. The larvæ of at least three species have this season devastated the cornfields of eastern Ohio, one of which appears to feed below ground exclusively. For my part, I am puzzled to know how to deal with these. Can it be done by breaking the sod in early summer, and allowing the wind and sun to

dry out and kill the grass roots, thus starving the very young worms? The plan of breaking the ground very late in spring and planting the crop immediately I find often fails of protection.

In conclusion, permit me to direct attention to the fact that the field of the economic entomologist is but poorly defined. To work out the life-history of a species and study its relations to other forms of life, learn what substances will destroy it, determine what course of procedure is calculated to prevent its breeding, would appear to constitute our true field of labor, but we are expected, by some sort of magical power, to transform ourselves into carpenters, mechanics, or civil engineers, and devise machines, methods, and all the details of application in a manner to fit the current notions of agriculturists.

Now, it seems to me that this is not necessarily all applied entomology. It belongs, it appears to me, equally as much to the science of applied agriculture, and I am in favor of giving the farmer the opportunity of putting his own shoulder to the wheel and exercising some of his own ingenuity to help himself. Outbreaks of injurious insects, like the diseases of the human system, are due to certain foregoing causes over which the entomologist has no control whatever, but when the trouble comes we are expected to go out and instantly stop it. You all know how impossible this is, and yet how difficult it is to make people understand the impossibility of it. I think that at present we are doing our whole duty and even more.

I congratulate the members of this association on the progress we are making. No nation on earth is or ever has made such rapid advances. We make some mistakes it is true; who that does anything at all does not? Honest errors are not only no disgrace but may be of value to those that follow after. We are profiting by the mistakes of Harris, Fitch, and Walsh; why may not those who shall carry the work forward after we are gone likewise profit by ours?

In discussion, Mr. Howard stated that *Isosoma tritici* occurs outside the limits Mr. Webster assigned it, since it has been found east of the Alleghanies. Further discussion was prevented by the necessity for adjourning for the boat ride on Lake Mendota.

Adjourned.

FOURTH SESSION—AUGUST 16.

The association met in room 24 and was called to order by the president at 9 a. m.

Mr. Summers moved that Mr. G. C. Davis be elected a member of the association. It was carried.

As chairman of the committee on the president's address Mr. Osborn reported as follows:

Your committee, to whom were referred the recommendations in the president's address, would report that they favor the adoption of such recommendations, and recommend the appointment of a standing committee to present a detailed plan for coöperative work among members, and to make recommendations concerning legislation.

HERBERT OSBORN, *Chairman.*
JOHN B. SMITH.
H. GARMAN.

The report was adopted, and Messrs. Osborn, Smith, and Garman were appointed as such committee.

The president at this point called Second Vice-president Smith to the chair, and the discussion of Mr. Webster's paper on grain insects was resumed.

Mr. Forbes remarked that it can not be inferred that the Hessian Fly is single brooded in a region where no winter grain is raised on the evidence of the absence of winter grain alone, since volunteer spring grain may give opportunity for the breeding of a second generation, and in this connection instanced an observation of his own in the spring-wheat region of northern Illinois where the fly is admittedly double-brooded, but where he found it infesting barley in spring.

In reply to questions Mr. Webster stated that a difference in the relative injury by Hessian Fly observed by him in two fields was due to the better condition in which the ground was kept in the case of one of them, so that wheat sown late enough to escape the fall attack grew rapidly and went into the winter in prime condition, while in the other field the wheat, if early sown, was infested, and, if sown late, was winter killed.

Mr. Webster stated in this connection that the fall brood of the fly scatters everywhere for oviposition, while the spring brood does not range widely, but is most likely to lay again on other plants (suckers, etc.) in the same field.

Mr. Riley asked Mr. Webster to give some account of the actual experiments and observations which had led him to make the statements in reference to the Apple Aphis (*Aphis mali*). He had for a number of years known that this species had a summer existence on various grasses, and had been very anxious to have Mr. Webster, while an agent of the Division of Entomology, follow the full annual cycle of development so far as the wheat plant was concerned.

Mr. Webster said that he felt that his experiments were sufficiently conclusive.

The following paper was then read:

FUMIGATION WITH BISULPHIDE OF CARBON FOR THE COMPLETE AND RAPID DESTRUCTION OF THE INSECTS WHICH ATTACK HERBARIUM SPECIMENS, FURS, WOOLENS, ETC.

By H. DU BUYSSON, *Brout Vernet, France.*

The fumigating chest for use with bisulphide of carbon has been employed for many years in the preservation of unpoisoned herbaria, which would infallibly be devoured without this annual or biennial precaution. These fumigations may render great service in the preservation of other objects more useful than the specimens of a herbarium. I shall describe, therefore, the first method used, and every one will know how to apply it to his own needs.

DESCRIPTION OF THE FUMIGATING CHEST.

It is in principle a rectangular box of light wood, lined with thin zinc, which is carefully soldered at all joints. Around the edge of the box, inside, runs a little gutter of zinc, carefully soldered. This gutter is filled with water and serves to make a water seal by means of the flange of the lid, which is also covered with zinc and carries all around a strip of the metal bent at right angles, and long enough to plunge into the water in the gutter. In this way the box is hermetically sealed and the vapors of the bisulphide cannot possibly escape from it.

USE IN THE PRESERVATION OF HERBARIA.

Botanists now generally poison their specimens, and the fumigating box is seldom used. Nevertheless it has served me well and I still resort to it from time to time, to preserve such plants as I have not time to submit to the action of arsenic in alcohol or to bichloride of mercury.

The process in question is based upon the great volatility of bisulphide of carbon at ordinary pressure and moderate temperature. The penetration of its vapor is so considerable that we have only to pile up in the chest the mounting-sheets of the herbarium, one above the other, in order to fumigate them. They are penetrated to the very center and eggs, larvæ, and perfect insects, Anobium or Attagenus, are killed. Space should be left and right of the pile for the vessels containing the bisulphide. Those which I use are of zinc and measure 10cm. long, 6cm. wide, and 9cm. deep. There is no risk in prolonging the fumigation; on the contrary there is but the greater certainty of its being efficacious. Five or six days will be time enough. No limit need be set to the quan-

tity of bisulphide used; what is not evaporated will serve for a new charge.

The disagreeable odor of bisulphide of carbon is not persistent; it is not even necessary to spread open the mounting-sheets; it is only necessary to expose them, unopened, to the air. I would call attention, however, to one very necessary precaution, if accidents are to be avoided. The vapor of bisulphide is very inflammable, and the chest must, therefore, be set in a safe place and not opened near a fire or any flame whatever. It would be risky, for example, to unpack the chest in the evening while holding a lamp in the hand.

As the odor of bisulphide is very disagreeable and may cause discomfort to some persons, all these operations should be performed in an attic or in an apartment of which the windows may be left open as long as necessary.

PRESERVATION OF FURS AND WOOLENS.

The same process may be used in the preservation of clothing in clothing establishments, civil or military, where Tinea and Attagenus sometimes cause such ravages. Special arrangements may be adopted in establishing fumigating chests or rooms to avoid the settling due to weight and to facilitate the penetration of the gas.

This method makes it certain that we shall not "shut the wolf up in the sheepfold." Articles fumigated are entirely rid of eggs, larvæ, and living insects. They may be shaken out in the open air for greater security and then replaced on the shelves, with the assurance that they will not be found gnawed when next visited.

PRESERVATION OF THE STUFFING OF FURNITURE AND SADDLES.

Tinea and Attagenus have a marked predilection for horsehair, so that these insects are sometimes found flourishing in the stuffing of our furniture, even that which is in daily use. This process has the advantage of permitting us to destroy them without having recourse to the upholsterer; we need but to construct a fumigating chest large enough to contain a couple of armchairs or more. In the same way we may treat mattresses, eiderdown quilts, or anything which is supposed to contain eggs or larvæ.

I have experimented with a saddle much damaged by moths, and after fumigating it five days noticed no appearance of insects; the saddle was completely penetrated by the vapor and all the moths perished. I kept it two years under observation in order to be assured of the efficacy of the process.

DISINFECTION IN EPIDEMICS.

I am persuaded that clothing subjected to this process would be disinfected quite as well as by the processes usually employed in certain epidemics, such as typhus, cholera, smallpox, etc. It seems to me that

the vapors which penetrate fabrics so well and kill insects so thoroughly would act in the same way upon the microbes which engender epidemics.*

In discussing this paper Mr. Atkinson stated that he had used a very similar box in fumigating objects infested with insects.

Mr. Garman called attention to the fact that at the museum of comparative zoölogy at Cambridge a large upright zinc-lined case was constantly used for disinfecting the skins of birds and mammals.

Mr. Riley had used bisulphide of carbon successfully for his insect collections.

Mr. Smith had used it successfully for ants, and found it not injurious to vegetation.

Mr. Garman reported having found it effective in destroying the Melon Louse. His method of applying it was to roll the vines up in a heap, then invert a tub over them, and after placing a saucer containing a tablespoonful of the bisulphide under the tub its edges were pressed down into the soil or the earth was drawn up when necessary. He had tried the fumes of burning sulphur and tobacco, but the former injured the plants and the latter did not kill the plant lice, many of them gradually recovering after being stupefied by it.

Mr. Smith thought since the aphides often spread from particular plants or hills, the use of bisulphide in good season might make it possible to prevent the injuries of these insects.

Mr. Forbes, who had been prevented by his duties as presiding officer from taking part in the discussion on parasitism when this subject was before the association, was called on to give his views on this subject. The gist of his remarks was that parasites and hosts keep a pretty constant ratio to each other when in natural conditions. Under disturbed conditions he thought the practical view is that parasites are beneficial.

The following paper was then read:

APHELENCHUS OLESISTUS NOV. SPEC., A NEMATOID WORM, CAUSE OF A LEAF SICKNESS IN BEGONIA AND ASPLENIUM.

By Dr. J. Ritzema Bos, *Wageningen* (*Netherlands*).

(Read, in the author's absence, by G. F. Atkinson.)

In the report of the third annual meeting of the Association of Economic Entomologists (Insect Life, Vol. iv, p. 31) Prof. G. F. Atkinson gives some information on a species of Aphelenchus, discovered by Dr. Byron D. Halstead in the leaves of sick plants of Chrysanthemum and Coleus. Prof. Atkinson says of the effects produced by this para-

*Note.—I have observed in bisulphide of carbon no clearly defined power of taking out the colors of fabrics which I have subjected to its vapor. It may, therefore, be used without fear, except, perhaps, in the case of the most delicate tints.

sitic worm: "It makes no swelling or deformity, as do many other Anguillulids, but causes a brown patch on the leaves." I have not before met a more ample description of this species.

I avail myself of the opportunity kindly offered to me to recommend to the attention of the members of the Association of Economic Entomologists a treatise of my hand, inserted in the recently published second number of the "Zeitschrift für Pflanzenkrankheiten," edited by Prof. Sorauer (vol. III, p. 69), a copy of which I took the liberty to send annexed to the secretary of the Association. In this treatise I describe a new species of Aphelenchus, which causes a disease in the leaves of Begonia and those of *Asplenium bulbiferum* and *A. diversifolium*, and which produces no hypertrophy or gallification, as do indeed all other nematoid worms living parasitically in plants, as far as I know them, but makes the affected parts die away immediately without any preceding deformity. My new nematoid worm causing the death of the tissues, I named it *Aphelenchus olesistus* (*ὀλ—εο*, radical of *ὀλλύναι*=to destroy; *ἱστος*=tissue).

For a minuter discription of the species I beg to refer to my treatise in the "Zeitschrift für Pflanzenkrankheiten" (III, p. 75–78). Still, I permit myself to state concisely the characteristics which distinguish my new species of Aphelenchus from the other well-known species of this genus. I have indeed some surmise that my new species is identical with the species meant by Prof. Atkinson in the above-mentioned information.

Firstly, I build my conjecture on the fact that both cause the decay of the parts of plants in which they live without causing gallification or hypertrophy as preceding symptoms, the more so, because all other kinds of Nematoids living parasitically in plants, as far as is known, give rise to the said deformity, and only after that, having strongly multiplied in the tissues, cause the death of the cells.

Secondly, I observe that the Aphelenchus of Prof. Atkinson, as well as mine, can live in very unlike species of plants, but that both were till now discovered in pot plants only.

In order to contribute to a decision, if possible, whether the Aphelenchus of Prof. Atkinson be or be not identical with my *Aphelenchus olesistus*, I give here a very concise description of the latter.

Description.—Length of the males, varying between 0.51 and 0.62 mm. (average, 0.58 mm.); that of the females, varying between 0.55 and 0.81 mm. (average, 0.68 mm.).

The proportion of the length to the greatest breadth of the body lies between $\frac{39}{1}$ and $\frac{53}{1}$.

The proportion of the length of the body to that of the œsophagus ranges between $\frac{12}{1}$ and $\frac{9}{1}$.

The spear is very delicate and small, becoming thicker to the back part and without ending in a knob.

The vulva lies at about one-third of the length of the body from the hindmost extremity of the body. The ovaria are double; one of them is found before, the other behind the vulva; the latter ovary is the shorter of the two.

Spicula of the male slightly bent, length, 0.009^{mm}.; accessory part very small.

In discussing this paper Mr. Atkinson remarked that, while there were characters present in the species he had described that seemed to place it in the genus Tylenchus, he had been of the opinion from the first that his species was introduced into the United States, and would not be surprised if it should prove, on more careful examination and comparison with the one described in the paper just read, to be identical with the latter.

The following paper was then read:

METHODS OF ATTACKING PARASITES OF DOMESTIC ANIMALS.

By HERBERT OSBORN, *Ames, Iowa.*

In dealing with insect parasites of domestic animals we need to consider, first, the method of attack of these parasites, and we may conveniently separate them into the external parasites and the internal parasites. Among the former we have various species of lice, itch-mites, ticks, and can also include those forms which affect the external parts of the body by depositing eggs in sores. In the latter series we may include the different kinds of bot flies affecting the internal organs and certain forms of degraded Acarina which also affect certain internal organs. It is unnecessary here to detail the mode of attack of the external forms more than to mention that some pierce the skin to suck the blood, others simply feed upon external excretions of waste material, while others may burrow beneath the epidermis, producing pustules, scabs, etc.

First among the methods of treatment we should consider that of prevention, since, for perhaps the majority of the parasitic forms, a little effort in the direction of prevention is far more effective than costly and laborious methods later on.

With a large majority of parasitic species, including all of the lice, the sheep-infesting Hippoboscidæ and all of the Sarcoptidæ, infection results from the mingling of parasitized animals with those which are free from parasites. It is therefore possible by attention to animals introduced into a herd, or sometimes into a new section of country, to prevent entirely the introduction of the parasites. To accomplish this it is necessary to examine introduced animals, and if infested, or suspected of being infested, use thorough treatment upon these. In the case of introduced cattle infested with Hypoderma it would seem possible that they might, by being carefully watched and the grubs destroyed, be prevented from introducing this pest in any new locality. Since the parasite occurs only in the bodies of cattle during the winter season, I see no reason why attention to imported cattle should not serve to totally exclude this pest from any locality which has hitherto been free from it. The bots in horses may be pre-

vented by the well-known method of shaving off the eggs, so as to prevent the introduction of the larvæ into the mouths, while for the bot fly affecting the sheep I am not aware of any more effective plan of prevention than that of applying tar to the noses of the sheep. For direct treatment, the methods for external parasites may be grouped under the head of washes, powders, and fumigation. The use of washes in the treatment of parasites is perhaps one of the oldest methods. The modifications consist in the methods of applying or in the materials used as a wash. The method of application will depend somewhat upon circumstances, but should aim to reach all parts of the body, and particularly those parts most infested. Sponging the animal with a cloth or sponge dipped in the insecticide material and application by means of force pump in certain cases, particularly for hogs and thin-haired animals, is practicable in certain forms. A device recently presented by Dr. Francis, of Texas,* provides for the pressure by means of gravity, the barrel being elevated on a derrick and connected by hose with several nozzles directed downward, and a movable one to use in spraying the under parts of the body, the liquid being collected from a drip platform in a receptacle below. The liquid, however, is elevated by a pump, and while it may lessen the number of men necessary in spraying, the same end can easily be accomplished where a force pump is at hand, if it is connected with several nozzles adjusted so as to play at proper angles on the animal. Dipping is probably the most speedy and effective method to use on a large scale, and especially for thick-haired or woolly animals, and for this purpose receptacles ranging all the way from a small tank for the treatment of a single animal at a time up to a large tank, including two or three dozen sheep at once, may be used. The ingredients for these washes have consisted mainly of tobacco, sulphur, lime, tar, kerosene, and arsenic, and each of these materials will be found to have its advocates.

Special formulæ for their combinations have been published in abundance, and need not be repeated here. Aside from these published formulæ there are different preparations on the market, some of which are doubtless valuable, and if the item of expense is considered satisfactory, it is perhaps proper to recommend their use. Kerosene emulsion has been used with success by Prof. Gillette† on cattle and hogs, and by Dr. Orcutt and Mr. Aldrich‡ for sheep dip, but Prof. Francis pronounces it less satisfactory than some of the proprietary combinations for ticks on cattle. I have also seen some reports of poor success with it or apparent injury, especially to lambs, from its use.

While I fully believe in its efficiency when properly made and applied and would attribute failures to improper preparation, the fact

* Bulletin Texas Ag. Exp. Sta., No. 24, p. 256.

† South Dakota Exp. Sta. Bulletin No. 30, pp. 16, 17.

‡ Iowa Exp. Sta. Bulletin No. 11, p. 495.

that such failures occur in practice is somewhat unfavorable to the general adoption of this remedy.

The various powders used are tobacco, sulphur, pyrethrum, snuff, and common road dust (the latter presumedly acting by closure of the spiracles), and of the other substances, tobacco or preparations including this material may probably be considered as most generally useful.

Pyrethrum, if dusted in among the hairs so as to thoroughly reach the insects when first applied, is quite effective and may be used for fleas and lice, but probably would not affect the mites.

Fumigation is a method which presents some advantages where it is practicable, because it can be used during winter, when washes are objectionable and is preferable to powders, because all of the individuals affecting an animal may be killed and thus entirely free it, whereas by the other method the survival of a few individuals may restock the animal. A simple plan of adopting this is to cover the animal with a blanket, leaving the eyes and nose exposed, but having the blanket reach the floor or ground and made as tight as possible at all points to prevent the escape of fumes. Puff tobacco smoke under this blanket by means of a bee-smoker. This plan first came to my notice as recommended by Mr. Charles Aldrich, who claims for it very effective work. I have also seen a description of a plan for fumigation of fowls which involves the same principles. Some years ago* I suggested the plan of using a tight stall, with an opening for the head, a canvas protection, so as to leave the head, eyes, and nose exposed and free; and some experiments with this method showed that fumes of either sulphur or tobacco are very effective in destroying lice, both the Pediculidæ and Mallophagidæ. The time of exposure to the fumes varied from twenty to twenty-five minutes in these experiments. The sulphur or tobacco were burned over an alcohol flame, but I should presume a preferable plan would be to place the substance in a tin or sheet-iron tube, closed at one end, with the open end projecting into the stall, and drive the fumes off by means of heat applied to the under surface. The common little lamp-stove could be used. The stall should be made as small as possible to accommodate the animal, in order that the fumes may be as dense as possible, and on this account the simple covering with a blanket is perhaps preferable, as it adjusts itself to the animal, but provision should be made for the free circulation of fumes on the parts of the animal where the blanket would press.

Feeding of sulphur with salt is strongly recommended by some, and Prof. Weed, of Mississippi Station, gives it a strong indorsement as a result of experiments at that station directed especially against the cattle tick (*Ixodes bovis* Riley).

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* Bulletin Iowa Ag. College, Dept. Entomology, 1884, p. 78.

Mr. Gillette asked how the hen louse could be destroyed.

Mr. Osborn, in reply, said he thought the use of tar on the ends of the poles in the henhouse could be made to answer this purpose.

Mr. Aldrich thought it not safe to recommend the use of kerosene oil for destroying insects on animals, because of the injurious effect on the skins of the host.

Mr. Gillette replied that he agreed that kerosene should not be used for sheep, but for hogs and cattle it was useful.

Mr. Riley remarked that he was deeply interested in the change of opinion resulting from later experience and experiments regarding the usefulness of the kerosene emulsion in destroying animal parasites, and particularly in Mr. Gillette's altered experience in reference to its use on sheep. He thought, however, that the difficulties of making a good kerosene emulsion and of getting intelligent farmers to use it safely were unnecessarily magnified. He could not accept the doctrine that of two given remedies the poorer one was to be recommended because the better required a little more care and intelligence in making and using.

Mr. Hopkins had used sulphur for stock at all times and found it not injurious.

Mr. Weed reported that sulphur and salt mixed were fed to stock in Mississippi for ticks. Some thought it ineffective. But it was tried at the station and found to be a complete remedy. It had been claimed that sulphur used during wet weather was injurious, but this was tried and found not to be true. Sulphur had been supposed to cause a decrease in the quantity of milk, but careful experiments at the Mississippi Station had shown this to be untrue. The sulphur and salt should be kept in use constantly. Ticks, he thought, infested by preference animals in poor health, and the chief good done by feeding sulphur and salt was keeping up the health of stock by destroying internal parasites.

Mr. Gillette inquired if the real bedbug ever occurred in hen houses. A case occurred in Iowa where bugs, which appeared to be the same as that found in dwellings, were abundant.

Mr. Howard remarked that Townsend, of New Mexico, had recently discovered another species (*Cimex inodora* Dugés) in henhouses.

Mr. Osborn thought the characters of the form occurring in henhouses might be considered either varietal or specific.

The following paper was then read:

REMEDIES FOR INSECTS INJURIOUS TO COTTON.

By HOWARD EVARTS WEED, *Agricultural College, Mississippi.*

There are but two species of insects which are especially injurious to cotton—the Cotton Leaf-worm, *Aletia argillacea*, and the Cotton Boll-worm, *Heliothis armiger*. While there are several other Lepidopterous species, especially *Arctia rectilinea*,* which occasionally may do considerable damage, and many Hemipterous species, which do a certain amount of damage each year, these do not demand the attention which the Cotton Leaf-worm and the Cotton Boll-worm should receive. The object of the present paper is to present the latest, and what I consider the most effective, methods of dealing with the two last-named species.

THE COTTON LEAF-WORM.

Owing to the amount of injury caused by the Cotton Leaf-worm and consequent great financial loss to the cotton planters of the Southern States, this species was one of the first to receive attention at the hands of the U. S. Entomological Commission. We cannot but admire the admirable work done by this Commission in the investigation of the habits, life history, and remedies for Aletia, but the past ten years have made a great difference in economic entomology, so that the same remedies recommended by the Commission may not be the best to-day. In ante-bellum days, before applied entomology came to the rescue of the southern cotton planters, little or nothing was done in trying to destroy the Aletia in years when the species was abundant. In such years the cotton crop suffered an immense loss. Some planters, however, tried primitive means for the destruction of the Aletia, such as the picking of the worms by hand. Lights were also used by many, both for the Aletia and Heliothis. Lights are yet used in some localities very largely, but most planters have now abandoned the light method, as it has been many times pointed out by entomologists and others that the lights in the cotton fields do more damage in destroying beneficial insects than they do good in destroying the injurious forms.

Paris green is the insecticide mostly used in destroying the Aletia, although some few planters use London purple. It is applied by means of a simple apparatus which, for want of a better name may be designated as the "Cotton Dry-poison Duster." This duster consists simply of a pole six feet long, at each end of which is attached an osnaburg bag about a foot long and six inches wide. The pole is generally made of hickory and the bags are tacked onto the ends. A small

*NOTE.—At the Rochester meeting of the Association of Economic Entomologists (INSECT LIFE vol. V, p. 111) I reported this species as *Arctia phyllira*, but Dr. Riley afterwards identified it for me as above.

hole is made through the pole near each end, the holes being stopped with plugs either of wood or cork. These holes open into the bags, and through them the bags are filled with the insecticide used. This distributor is generally operated by a darkey on a mule and going at a brisk trot, the vibration being sufficient to shake the insecticide from the bags and distributing it very well. This duster can be rigged up at very little trouble and expense, and forms the most simple apparatus for the distribution of dry poisons that I have yet seen. It is needless to say that it can be used to apply dry insecticides to plants other than cotton. Used in the cotton fields four rows are treated at a time, the bags at each end of the pole being held over the space between the rows. At first thought one might think that in this way much of the insecticide would be wasted by falling upon the ground between the rows; but such is not the case, for when the cotton is nearly full grown it so completely covers the ground that there is little waste.

Another apparatus used in the cotton fields for the distribution of dry Paris green is the Roach poison distributor, manufactured by J. P. Roach, Vicksburg, Miss. This machine is used upon many large plantations, but most planters use the above-mentioned cotton dry poison duster, as it is so cheap and easily operated. The Roach distributor sells at about $60, putting it out of the reach of the average cotton-grower. When the Roach distributor is used the Paris green is diluted with about ten parts flour or lime, while in using the cotton dry poison duster preference is given to undiluted Paris green. About 10 acres can be gone over in a day with the cotton dry poison duster and about 30 acres when the Roach distributor is used.

While the Aletia could be destroyed by many insecticides other than Paris green or London purple, yet these are the best for this purpose, and these are much more easily applied in the dry form than when mixed with water. Insecticides mixed with water do very well on a small scale, but when several acres are to be gone over dry insecticides are to be preferred, owing to the difficulty of getting the water in the field and the added trouble of hauling it about.

THE COTTON BOLL-WORM.

The remedies for the Cotton Boll-worm are far less satisfactory than the remedies for the Cotton Leaf-worm; for the former, owing to its working within the boll, cannot well be reached from the outside by the application of insecticides. The first brood of Boll Worms is produced upon corn soon after it is up, where it is known as the "Bud Worm." Here it often does considerable damage, and when the corn becomes older and the leaves unfold, it readily shows where the worms have been at work. The second brood attacks tomatoes, and between the worms and the tomato rot in some years it is impossible to raise a crop. I am inclined to think that the worms get the credit of destroy-

ing many tomatoes where the cause is really due to the tomato rot. The worms are much more apt to attack tomatoes slightly affected with the rot than sound tomatoes.

There are always some Boll Worms every year, but in some years there are but a few, while in other years they are very abundant. Scarcity or abundance, however, in one locality does not necessarily mean a like condition in another locality. Thus at the Mississippi Agricultural College last year, especially toward the close of the season, the Boll Worms were very abundant, but this year there are scarcely any, while at Columbus, 25 miles distant, they are reported this year in great abundance.

As the Boll Worm works *within* rather than *without*, I doubt very much the practicability of the application of any insecticide to destroy them. Success in this direction would be more apt to follow with the Boll Worm upon tomatoes than upon cotton. Upon tomatoes the insecticides would have to be applied to all parts of the fruit, the underside as well, and it would also have to be applied several times during a short growing season. With cotton the bolls are somewhat concealed and the eggs are deposited at the calyx or underneath, where it would be difficult to place an insecticide. So that so far as our present knowledge goes we may say that the application of insecticides for the Boll Worm is impracticable.

Much has been done in the way of poisoned sweets, but with little success. Lights, as already stated, do more harm than good. Fall plowing has been recommended and no doubt would do much good, especially if the ground was well broken several times during the winter if the weather would permit. Farmers say as to this, however, that fall plowing was universally practiced in ante-bellum days, yet the Boll Worms were then if anything more numerous than at present.

The only effectual way of dealing with the Boll Worm is by means of trap plants, *i. e.*, by planting other food plants in the cotton fields upon which the Boll Worm will feed in preference to the cotton. I consider corn more effective for this purpose than cow peas or other plants. The Boll Worm attacks corn when first up and also when the ears are forming. I consider the best plan that of planting a row of corn about every tenth row throughout the cotton. The corn may be planted at the same time as the cotton, or better a little later, so that it will mature early in September. Some may say that this forms a good food plant for the Boll Worms and favors rather than decreases their numbers. Success in this trapping lies in the fact that the worms feed upon each other, and where there are several within an ear of corn it becomes a struggle for life in which the strongest survive. They thus destroy themselves, and besides this birds, especially sap-suckers and blue jays, also destroy great numbers. Parasites also are more apt to reach maturity when this plan is followed. Mally and others have recommended three plantings of corn in the cotton fields at different times

and then either destroy the worms by hand or gather and feed the corn while the worms are still within the ears. Very few cotton-growers would adopt this method of three plantings, as they would regard it as too much trouble. Planting trap rows but once, however, and having to do nothing to them but to cultivate along with the cotton, will be and is practiced quite largely. If this was practiced still more extensively we would not hear so much complaint about loss through damage by the Boll Worm.

Mr. Webster thought the chief difficulty in improving methods at the South was due to the ignorance and incompetence of the colored help.

The following paper was then read:

THE CHEESE OR MEAT SKIPPER.

(*Piophila casei.*)

By MARY E. MURTFELDT, *Kirkwood, Mo.*

In dealing with the insects detrimental to agriculture the entomologist encounters no obstruction in the reluctance of the farmer to have his losses made known. With the pessimism characteristic of the profession, the latter is inclined to exaggerate rather than to make light of his difficulties and losses, and therefore gives the fullest publicity to any agency from which he suffers; but in the investigation of the habits and economic relations of an insect injurious to manufactured products the case is very different. The prudent manufacturer or merchant is very careful not to give to the public any fact which might arouse suspicion concerning the quality or durability of his products or wares. In the case of manufacturers such caution is especially necessary, as the tide of trade is so easily turned, and there are so many rivals in the field eager to take advantage of the smallest fact to the prejudice of a competitor. As an instance of this, one of our shoe manufacturers in St. Louis found, some years ago, that his stock was being injured by the Leather Beetle (*Dermestes vulpinus* Fabr). In his desire for a remedy he very appropriately applied to Dr. Riley, of Washington, who instituted an investigation as to the nature of the depredator and the means for eliminating it. I had the honor to assist in these studies, and I well remember the change of manner in the proprietor of the concern between the first visits to his establishment and those made later. At first every facility for observation was granted, and all questions fully and obligingly answered; but subsequent visits were somewhat coldly received and very little information could be elicited, and there was a general air of desiring to ignore the whole matter. This was explained sometime afterward, when a part-

ner in a rival firm chanced to mention that his business had profited considerably by the publication that So-and-so's shoes were "wormy"; and the latter declared that the attention which the "bug-hunters" had drawn to the matter "had damaged his trade to the extent of several thousand dollars." Such experiences inculcate caution in mercantile circles, and through this the entomologist undoubtedly loses many an interesting subject for study. Perhaps this might be amended if it was understood that names would not be published without permission.

In the case of the insect upon which I beg here to offer a few notes, no household pest is, perhaps, better known. The manufacturer, the grocer, and the housekeeper have each a considerable share in the loss which it occasions. For ages it has been the chief enemy of the cheese-maker, the best and richest of his products being most liable to its attacks. It does not, however, confine its ravages to cheese, but within comparatively recent years has become known as an equally, or rather far more, formidable destroyer of cured meats, causing the loss of thousands of dollars worth of property annually, and necessitating the expenditure of other thousands in labor and mechanical contrivances to keep it in check.

Although of European origin it has spread to all parts of North America, where it probably does tenfold the damage that it does in its native country. In view of these facts, and considering the hundreds of articles that have been published upon insects of no greater economic importance, it is really surprising that the American records of this pest should be so few and so brief. Before entering upon an investigation of its habits I made a search for the literature of the subject only to find that it had received but slight attention from our entomologists, from either a scientific or an economic standpoint. The only notes relating to it that are to be found in the annals of American Economic Entomology are the following:

In the *American Entomologist* (vol. II), published in 1870, is a copy of an article by X. A. Willard, giving a somewhat elaborate account of the destructiveness of the insect as a "cheese fly," with various recommendations of measures to be taken in factories and storerooms to preserve the products from its attacks. Appended to this is an editorial note giving an outline of its life history, with the statement that, so far as was then known, it was exclusively a cheese pest. In volume III of the same periodical, published in 1880, Dr. Riley briefly discusses it as an enemy of cured meats, here asserting its identity with the cheese fly. Dr. Packard, in his Guide, gives in a few lines its principal characteristics and refers to an observation of Prof. Putnam concerning the method by which it "skips." In volume IV of *Pysche* I remember to have seen something on the subject, but can not at present lay my hands upon the number containing it. In the report of the Entomological Society of Ontario for 1884 is also a brief paragraph of description

of it as a cheese pest. Not doubting that there were other works not in my library, in which it was more fully discussed, I applied to Dr. Williston, as our leading dipterologist, who very kindly answered:

> I, also, have had occasion to search for the life history of *Piophila casei* without success. I supposed there would be no difficulty in finding a full description of its habits, but was surprised to find no, or very meager, references in any literature at my command. * * * If you have studied its habits you will do a service by publishing them, even though it may happen that they have already been published, which I doubt.

Dr. Riley, however, informs me that the literature of the insect is sufficiently extensive though scattered, and that several European writers, and especially H. F. Kessler, have within recent years given careful accounts of its development and life history.

As it was my desire to bring the matter to the attention of the economic entomologists at the present meeting, I did not have time to obtain transcriptions from the authorities to which Dr. Riley refers, and so will offer here a popular synopsis of my personal observations, in which I am conscious there are some gaps and uncertainties. Those desiring a more minute and technical account can consult the works named by Dr. Riley.

My attention was directed to this pest about a year ago by an employé of one of the largest packing and curing establishments in the West, who wrote: "We wish to know what it is, and especially at what period in its life it can best be fought. It entails an enormous loss upon all our packing-house companies." Upon my request specimens of the infested meat were kindly sent me, and Mr. D——, my correspondent, gave me much valuable information concerning its work in the packing house.

The packages of ham and shoulder were received during the month of August, 1892, and consequently represented the worst work of the insect for the season. Swarms of flies escaped from the boxes as they were opened and myriads of "skippers" and puparia in all stages of development were disclosed, clustering around the bony ends, among the tendons, and in the softer fat and oil-saturated folds of the canvas wrappers. The lean meat was never in any case penetrated, although eggs and small skippers were abundant on the surface; nor was the solid fat much damaged. The methods of curing these meats had been so perfect, that even after an exposure of two or three weeks in an open shed to the August heats, upon cutting into the center of a ham and the thickest part of shoulder they were found to be perfectly sound and sweet. In justice to the "skippers," too, I must say that their work does not induce putrescence or ill odors, and although the spectacle of a ham swarming, externally, with the various forms of the insect is the reverse of appetizing, yet a large part of it is still edible and, the outside carefully removed, would be available for potted meats and similar preparations. But, of course, in the original shape it is absolutely unsalable; hence the loss.

The life history of the insect, so far as I have been able to trace it, is as follows, popularly presented: It hibernates in the perfect state, hiding, like the house fly, in cracks and crevices of the buildings which it frequents and behind furniture and machinery. The flies become active only when warm weather sets in. According to my informant they are first noticed, in the curing establishments, around the vats of "yellow wash" which is composed of glue, rye flour, and coloring matter, possibly attracted by the odor of the glue. If not rigidly excluded they follow the pieces of canvased and yellow-washed meat to the storerooms and deposit their eggs upon the wrappers, preferably among the folds, if they can find an opening that will admit them, otherwise upon spots where the fat has penetrated and loosened the wash. It has been difficult to ascertain the exact number of eggs laid by a single fly, as they are deposited not only in more or less compact clusters of from five to fifteen, but are also scattered singly. In the observation jars the average was about thirty, but it is possible that in these jars, confined upon small bits of meat and subject to much disturbance, the conditions were not normal and the number of eggs may, in consequence, have been reduced. Those of an individual seemed to be all deposited about the same time, in the course of an hour or less, soon after which the insect perishes. The egg is pearly-white, slender oblong, slightly curved, 1^{mm} in length, with a diameter about one-fourth the length. Hatching takes place within thirty-six hours and, leaving a filmy pellicle behind, the minute, translucent-white larva moves with wonderful activity in the direction of the food supply. Except in increase in size it does not change much in its characteristics. It is cylindrical, tapering gradually toward the anterior end, and is truncate posteriorly, furnished at this extremity with two horny, projecting stigmata and a pair of fleshy filaments.

There is no variation in the white color except in the retracted mouth-hooks which show a shade of dark gray. Dr. Packard, in his Guide, quotes from an observation of Prof. Putnam regarding the leaping power of the insect—

> When about to leap, the larva brings the under side of the abdomen toward the head while lying on its side, and reaching forward with its head and at the same time extending its mouth hooks, grapples by means of them with the hinder edge of the truncature and pulling hard, suddenly withdraws them, jerking itself to a distance of 4 or 5 inches.

To my knowledge the distance to which it "skips" is often much greater. I think the "skipping" a latent power in the insect as a meat pest, as there is no occasion to exercise it by the majority of the individuals. When breeding in cheese it would be necessary in many cases to escape by this means to some place in which it could transform in safety, but on the canvased packages of ham and bacon, the folds of the wrapper afford the most desirable of hiding places. It completes its growth in seven to eight days, attaining a length of from 7 to 9^{mm}

with a diameter at the posterior end of 1.5^{mm}. While feeding, if the food supply is sufficient, it does not move about much, entire clusters of larvæ often completing their growth in the same bony crevice in which the mother fly had deposited the eggs. When mature, however, it crawls, pulling itself along, apparently by the mouth hooks, into some fold of the wrapper that is comparatively dry and from which the fly will easily be able to escape. Here it begins to contract in length and assume a yellowish hue, and the separation of the outer skin from the body can be clearly seen. The former gradually hardens and darkens into a golden brown, oblong segmented shell, 4 to 5^{mm} in length, and which still retains the larval projections on the posterior end. Within this puparium the larva rests for a time, I have reasons for believing, for thirty-six or forty-eight hours, perhaps longer, unchanged, except for a slight reduction in size. (I had occasion to observe the actions of one of these larvæ whose case was accidentally broken. It wriggled and twisted about in the most unsatisfied manner, but seemed to have lost its skipping power, and was constantly thrusting its head or its posterior extremity into the deserted puparia that were scattered in the bottom of the jar. Whether it was able to complete its transformations I can not now say.)

Both transformations, although involving such radical, formal and functional changes, take place within a period of ten days, as nearly as I have been able to ascertain.

The perfect insect is a shining black fly with bronzy tints on the thorax and slight iridescence of the wings. The latter overlap nearly to the tips when the insect is at rest. The legs are dull black, shaded at the joints to dull yellow or fuscous. In size it is about one-half that of the common house fly. There is no good figure of this insect in any American publication, that in Packard's Guide being in outline merely and not available for recognition except by the skilled entomologist. The fly is not active at night, but is able to perform its life work in the obscurity of partially darkened closets and storerooms. To make these absolutely dark would, in my judgment, effectually exclude it.

I have not been able to make it oviposit on fresh meat of any kind, nor does it seem able to breed upon that which is simply salted, but not smoked, not even when such meat is folded in wrapping papers. It will sip a little at sweets, but is not greatly attracted to them, while the odor of smoked meat speedily summons it. The average duration of life, in the perfect state, in summer, does not exceed a week, according to observations made upon it in the rearing jar, which may not, however, exactly indicate it. The entire life cycle would seem to be included within three weeks, but there is no definite succession of broods, and the insect may be found in all stages from May until October or November. When exposed to severe and protracted cold, larvæ, pupæ, and flies are killed. The flies speedily succumb to

the fumes of burning sulphur or Pyrethrum powder, and the latter, if dusted upon them, produces the same stupefying effect that it does upon other Diptera. The firm in whose behalf these investigations were undertaken informs me that in order to exclude the fly they screened all windows and doors with a 24 to the inch wire mesh. They also, early in the spring, thoroughly whitewashed and fumigated smoke-houses and storerooms, using an admixture of carbolic acid in the whitewash, thus effectually sealing up or killing all hibernating individuals that might be lurking in these places. I have not been able to recommend any repellant chemical that could be safely incorporated with the wash used on the outside of the wrappers. Mr. D——— also informs me that sulphur fumes in the storerooms give a streaked and unattractive look to the wash, and the use of this repellant is therefore impracticable.

Smoked beef also suffers to some extent from the attacks of this insect, but, as Mr. D—— says, "not nearly so badly as pork. If a beef ham were hanging beside that of a hog, the former would most likely be O. K. while the latter would be stung."

In my correspondence with cheese manufacturers I learn that the loss of their products is now far less than it formerly was.

One of our leading cream-cheese makers writes:

> We are always somewhat troubled with the cheese flies in summer. To keep them out of our storerooms we cover the windows with light domestic, as they will go through the ordinary wire screen, but as there will always be more or less of them in the rooms, we have the brown fly paper in water always on hand, which keeps them pretty well in check. They are worst during the hot season. We do not use any chemicals as they would be likely to injure the quality of the cheese. The flies deposit their eggs on the outside of the cheese, and in thirty to thirty-six hours they begin to squirm and work their way inside, so we usually go through the rooms twice a day and look for eggs. They are easily found on the smooth surface, but if the bandage is wrinkled or cracked we sometimes miss them. We have not had over $5 worth destroyed in two years, and are turning out 800 cheeses per day.

Another large manufacturer informs me that he

> depends mainly upon fine screens to keep out the fly, and also darkens his storerooms; has each cheese rubbed hard each morning; uses no chemicals, but a cheese grease that contains some rosin, which gives a hard coating. Loss not more than 1 per cent., some seasons not over one-fourth of 1 per cent.

These reports are encouraging as showing with what comparative ease the insect may be kept in check when once its habits are thoroughly understood. It is hoped that these few, and not in all particulars conclusive, notes may prove of some assistance in popularizing that knowledge.

Mr. Aldrich spoke of an English custom of placing cheese under the tap of a beer keg so that the drip would encourage the development of the insect. He had been informed that the maggots improved the quality of the cheese.

Mr. Riley said it was true, that this was not only an English but a European practice.

Mr. Coquillett's paper on the use of hydrocyanic acid gas was read by Mr. Garman.

HYDROCYANIC ACID GAS AS AN INSECTICIDE.

By D. W. Coquillett, *Los Angeles, Cal.*

[Read by the secretary in the author's absence.]

One of the most important properties to be desired in any given insecticide is that it possess the ability to completely exterminate the insects against which it is directed. As a rule which has but few exceptions, the more prominently injurious insects are very prolific, and even if only a few individuals remain upon the plant, these in a comparatively short time will multiply to such an extent as to render it necessary to again employ artificial means for their destruction. For this and other reasons that might be mentioned, it is of the utmost importance that the insecticide employed will result in the almost or complete eradication of the insects against which it is directed.

Those who have had any experience with the destruction of scale insects on citrus trees by the use of liquid sprays of various kinds, soon become aware of the fact that even by the use of the best mechanical devices and the exercise of the greatest care in applying the spray, quite a large percentage of the insects will escape destruction. This fact was abundantly demonstrated a few years ago, during the prevalence of the Fluted Scale (*Icerya purchasi*) in some of the orange groves of Southern California prior to the advent of the *Vedalia cardinalis.* At that time the Supervisors of Los Angeles County offered a reward of $1,000 for an effectual remedy for destroying this pest, and appointed a committee of three, of which the writer was a member, before whom the various remedies were to be tested. One of the rules formulated by this committee was that the successful remedy must be able to entirely eradicate the Fluted Scales upon any given tree. Upwards of three dozen different tests were made, many of them by men who from long experience had become very expert in the matter of applying sprays to the trees, and yet in not a single instance were all of the scales exterminated upon one of the trees. In some instances, a curled leaf or a piece of loose bark would be the means of protecting the insects from the spray; and no matter how thoroughly the spraying was done, or how long-continued was the operation, a few of the insects were certain to escape the effects of the spray.

It was with a view to remedy this important defect that in the autumn of 1886 the writer began a series of experiments with various kinds of gases by inclosing the infested tree in a gas-tight envelope or

tent, and then filling the latter with the gas. It must be apparent to all that an insecticide in the form of a gas would reach not only those insects on the inclosed tree that would naturally have been reached by a spray, but also those that might be protected from the spray, since the gas would penetrate every nook and crevice on the tree; in short, would go wherever the air could go. But the gas also posseses another decided advantage over the spray. The application of the latter even when the most approved methods are employed is a laborious task, and the operators, becoming wearied with their work, are almost certain to slight it. To remedy this, a method is desired that operates on the principle of "You press the button—we do the rest." And this we have in the gas treatment. After the tent is on the tree to be treated, the button act consists of simply turning the chemicals into the generator—the chemicals do the rest.

Hydrocyanic acid gas was the first one that I experimented with, and although I have since tested a large number of other gases, including arseniuretted hydrogen, sulphuretted hydrogen, sulphurous gas, carbon bisulphide, nitric and nitrous oxide, ammonia, chloroform, carbonic acid gas, and carbon monoxide, yet none of them gave as good results as the one first mentioned. Some of the gases were much slower in becoming diffused throughout the space inclosed by the tent, others were more severe in their effects upon the tree, while several, which were commonly supposed to be very deadly to animal life of every description, produced very little impression upon the insects against which they were employed.

A long line of experiments which the writer carried, out under the auspices of our national Division of Entomology at Washington, establishes the fact that the best results will be obtained by generating the gas from undiluted commercial sulphuric acid and undissolved fused potassium cyanide of about fifty-eight per cent purity, the proportions being: one fluid ounce of the acid, one ounce by weight of the cyanide, and three fluid ounces of cold water. For a generator, almost any open earthen vessel will answer, its size depending upon the size of the tree or plant to be treated. The necessary quantity of water is first poured into the generator, followed by the acid, after which the generator is placed on the ground under the tent and the cyanide added. Experience has shown that the best time for treating the trees is at night, or during cool, cloudy days; at such times the trees are more or less in a state of rest, and therefore less liable to be injured by the gas than if subjected to it during bright, sunny days. Moreover, as is well known, this gas is not very stable even under the most favorable conditions, but it is less liable to decompose when kept at a low temperature than if subjected to any considerable degree of heat. For these reasons the best results will be obtained by using it only during cool weather, and experience has shown that the various

kinds of scale insects are quite as susceptible to its influence during cool weather, or at night, as they are at any other time.

It will, of course, be quite impossible to lay down any fixed rule in relation to the proper quantity of the chemicals to be used on any given tree. Experience has shown that a tree possessing a dense foliage will withstand unharmed a much stronger dose of the gas than will a thinly-foliaged one, the supposition being that in the former case the gas is distributed to such a great number of leaves that its effect upon each leaf is not so severe as would be the case if there were fewer leaves to receive it. In a general way, we may say that each 180 cubic feet of space inclosed by the tent will require one ounce of cyanide and the other materials in the proportions given above.

The material commonly used in the construction of the tents for inclosing the trees is what is known as "eight-ounce duck." At first it was the custom to manufacture this into bell-shaped tents, but experience has shown that simple sheets will answer the purpose quite as well as tents, besides being less expensive and much easier to remove from the trees. These sheets are made in the form of an octogon, since it requires less labor and there is less waste of material in constructing them of this form than would be the case if they were made circular.

In the case of very large sheets, it is customary to use a heavier material for the two middle breadths, since it is on this part of the sheet that the principal strain falls in placing the sheet upon the trees and in removing it again; for these two breadths the "ten-ounce duck" is used.

Several tests made with unpainted tents prove that it is not desirable to use them in this condition, since they permit of the escape of a large quantity of the gas, and in order to render them gas-tight they are painted over with linseed oil, with or without the addition of other substances. Among such substances may be mentioned yellow ocher, lampblack, sizing, whiting, beeswax, and soapsuds. Perhaps the substance most commonly used is a thin paint made from yellow ocher, this being lighter in weight and less expensive than most other paints. It would, of course, be very desirable to employ some kind of ready-prepared cloth in the construction of the tents, but thus far my efforts at obtaining such material have not been successful. The nearest approach to it is a rubber cloth, but even the cheapest grade of this is almost three times as expensive as the painted cloth described above.

In regions where cactus abounds, the mucilaginous juice of this plant may be used in place of linseed oil; the cactus is simply cut into small pieces, thrown into a barrel, and covered with cold water; after standing for a day or two it is ready for use.

Where the trees are less than twelve feet in height, the sheets can be placed over them and removed again by the use of poles, but on

trees taller than this an apparatus of some kind, furnished with ropes and tackle, will be required. The simplest apparatus of this kind consists of two upright posts, one on either side of the tree, with a pulley at the top of each and a rope passing through it and attached to the sheet. This simple device, which can be constructed in a short time by almost any person, can easily be moved by hand from tree to tree as occasion requires. In throwing the sheet over the tree the uprights are allowed to fall to the ground; being very light affairs, they are easily raised again when it is desired to remove the sheet from the tree.

After the sheet is on the tree the slack at the bottom is gathered in and pressed firmly against the ground by stepping upon it, this being sufficient to prevent the escape of the gas between the lower edge of the sheet and the surface of the ground. The gas, being lighter than the air, rises and diffuses itself throughout the inclosed space without the aid of any kind of artificial means, and this is true even in the case of trees thirty feet in height.

The length of time that the gas should be confined on each tree will depend on the size of the tree, varying from fifteen to thirty or even to forty minutes. By employing a sufficient number of sheets or tents, no time need be wasted by those operating them, since, by a proper adjustment, the tent first placed on the tree can be removed as soon as the last one has been adjusted and charged with the gas, and the removal of the other tents will follow in their natural order.

The use of this gas is fast superseding all other methods for destroying scale insects on citrus trees in southern California, and it could also be employed for the destruction of several other classes of injurious insects. The complete eradication of insects on imported nursery stock is of the utmost importance, and for this purpose the gas treatment is especially adapted. It must be borne in mind, however, that the effects of this gas are not the same upon the various different kinds of insects, and even among the scale insects themselves this fact is very noticeable. As a rule, the Diaspinæ are more easily affected than any other kinds; and, as might be expected, the insects themselves are more susceptible to the effects of the gas than are their eggs. Mites are but little affected by the gas beyond a temporary insensibility, or, at least, what appears as such, since in most cases they recover from the effects of their forced sleep, and appear to suffer no inconvenience therefrom. On the other hand, the gas is very fatal to spiders. Among the higher insects, the Diptera and Hymenoptera are very susceptible to its influence; Hemiptera and Coleoptera less so.

When I first began to use this gas as an insecticide, a great cry was raised against it on account of its very poisonous nature, as well as that of the chemicals used in its production. So very pronounced was this feeling that even the analytical chemists of this city refused to make an analysis of the potassium cyanide on account of its highly poisonous nature. And yet, in the past seven years, during which

time this gas has been largely used by myself and others, I have yet to hear of the first instance wherein a single human being has received any serious injury either from the gas itself or from the chemicals employed to produce it. Occasionally a barnyard fowl that may chance to be in the tree at the time it is treated will be sent into the next world by the shortest practical route; and small birds, as well as lizards, sometimes share a similar fate, but cases of this kind are rare, and could in most instances be prevented by exercising due precaution.

At the present price of the chemicals used, the cost of treating citrus trees with this gas will vary all the way from 5 cents to $1 per tree. This latter sum may seem to be an exorbitant one to pay for ridding an orange tree of the scale insects that infest it, and yet our fruit-growers find themselves well repaid for expending so large a sum of money for this purpose. One of the greatest pests at present infesting the orange groves of southern California is what is commonly known as the Black Scale (*Lecanium oleæ* Bernard); while this pest does not devitalize the tree it infests to the same extent that some other kinds do, still the black fungus, which always accompanies its attacks, renders the fruit so unsightly that it is necessary to wash the latter before placing it upon the market. The cost of thus washing a box of oranges amounts to about 20 cents per box. An orange tree large enough to require the expenditure of $1 to treat it with the gas will yield on an average fifteen boxes of oranges, and to wash these would require the expenditure of about $3, as compared to $1 to fumigate them. This fact is not merely a theoretical one, but has been demonstrated again and again by different orange-growers in this district. Not only is it cheaper thus to fumigate the fruit on the tree, but it also leaves the fruit in better condition, since, as is well known, washing oranges impairs their keeping qualities. In addition to this, the fumigated tree, being rid of the pests whose attacks continually weaken its vitality, will be in much better condition to produce a superior grade of fruit.

At a recent meeting of the county horticultural commissioners of southern California, one of the commissioners, Mr. B. J. Perry, reported having treated 47,000 citrus trees, at an average expense of less than 25 cents per tree. This is but slightly in excess of what it would cost to spray them, and this slight difference in the cost is more than counterbalanced by the better results obtained, the less labor involved, and the better condition the trees are left in after tne operation is completed.

The following paper was then read:

ON ARSENICAL SPRAYING OF FRUIT TREES WHILE IN BLOSSOM.

By J. A. Lintner, *Albany, N. Y.*

[Read, in the absence of the author, by J. B. Smith.]

The long-mooted question, Are honey bees poisoned by arsenical spraying? is still an unsettled one. There are those who claim that a great mortality among bees is the result of their visiting blossoms that have been sprayed with Paris green, while others hold that the mortality so frequently observed at this time is ascribable to other causes, and that the arsenic would not reach the nectar of blossoms, and, being an insoluble substance, could not affect the bees or be communicated to the honey. This latter view has been entertained by some of our best botanists. The pollen, however, might contain arsenic and thus become poisonous, not only to the bees visiting the blossoms, but also to the nearly-matured, chyme-fed larvae to whom it might be conveyed.

In behalf of a committee appointed by the Association of Economic Entomologists to investigate the matter, Prof. F. M. Webster, of the Agricultural Experiment Station of Ohio, chairman of the committee, has recently reported progress in the investigations undertaken, to the following effect: He had experimented with a hive of bees placed underneath a sprayed plum tree wholly inclosed with a fine netting. Within two days thereafter a large number of dead bees were taken up from the cloth with which the ground had been covered. Without much doubt, most of these had been killed in their efforts to escape from their confinement. Examination of the bodies of the dead insects before washing and after they had been washed to remove any arsenic that had been attached to their surface from contact with the sprayed blossoms, gave to the examining chemist the presence of arsenic. In another experiment made, hives of bees were placed under sprayed trees, but without any inclosing net. These also gave dead bees with arsenic upon them, but in much smaller number.* The experiments were not deemed conclusive by Prof. Webster, and it is intended to continue them another year.

That the bodies of crushed bees that had visited blossoms sprayed with arsenic should disclose to chemical tests the presence of arsenic is not at all strange. Even an ammoniacal bath could not have removed every trace of arsenic from the surface of their bodies.

* It is possible that these bees may have been caught and killed by some of the predaceous insects which are known to lie in wait among or near blossoms, whence they suddenly seize the bees and suck out their *juices*, such as the bee-slayer, *Phymata erosa*, and several of the "robber flies" or Asilidae, of which Prof. A. J. Cook records six species having this habit.

Prof. A. J. Cook, the distinguished apiarist of the Michigan State Agricultural College, makes the positive assertion that honey bees are killed in large numbers through the arsenical spraying of fruit trees in blossom, but he has not proven the assertion. Experiments instituted by him in which bees fed on sweetened water poisoned by arsenic—1 pound to 200 gallons—were killed, are claimed by him as decisive upon the question under consideration. How entirely unwarranted the conclusion! The experiment had no bearing upon the question at issue. No one could have doubted that imbibing strongly poisoned sirup would be fatal to honey bees. Furthermore, in his experiment (see Report of the Michigan Board of Agriculture for 1891) the bees were fed in his laboratory, within a small cage. Bees are known to die very soon in confinement, even without an arsenical diet. (Howard, in INSECT LIFE, Vol. v, 1892, p. 123.)

A simple method can be resorted to by which the question could be definitely and effectually settled. It is this: Confine a hive of healthy bees to blossoms sprayed with Paris green, and when death speedily follows, have examination of their stomachs made by experts testing for arsenic. If it is found therein, then it may be accepted as the cause of their death. Examination of stomachs of bees collected promiscuously would not be satisfactory, for the statement was made at a recent bee-keepers' convention in Albany that honey bees had been seen eagerly feeding on the liquid resting on the leaves of a potato patch soon after it had been arsenically sprayed, and it was thought to have caused the death of many of the bees.

Up to the present, so far as I know, no examination such as above suggested has been made. I hope that Prof. Webster will undertake it, in the progress of his experiments the coming season.

Prof. Cook desires that "everyone of the United States should pass a law making it a misdemeanor to spray fruit trees while in blossom." I do not know that this, although urged in some of the States, has been done in any. Such a law was passed by the Ontario legislature, in April, 1890. It provides:

SEC. 1. No person in spraying or sprinkling fruit trees during the period within which such trees are in full bloom shall use or cause to be used any mixture containing Paris green or any other poisonous substance injurious to bees.

SEC. 2. Imposes a penalty, on conviction, of not less than $1 or more than $5, with or without costs of prosecution.

That the above law is calculated to protect the interests of both the fruit-grower and honey-producer, is the opinion of Prof. J. H. Panton, of the Ontario Agricultural College, as given in Bulletin LXXXI, of the college, issued in November, 1892. He remarks:

Although there has been no analysis of the bodies of the dead bees for the purpose of ascertaining the presence of arsenic, still the death of the bees is so intimately associated with spraying that there seems but little reason to believe otherwise than that the bees have been poisoned by Paris green used in spraying. However, this will likely soon be settled by analysis of the bodies of bees suspected to have been poisoned, and I have no doubt arsenic will be detected.

There is another important question connected with the arsenical spraying of blossoms, viz, this: May not the arsenic blight the blossom and prevent fruit development? "The portion of the pistil," says Prof. Panton, "upon which the pollen falls is exceedingly tender and sensitive, so much so that the application of such substances as Paris green injures it to so great an extent that the process of fertilization is affected and the development of fruit checked." No experiments known to me have been made upon the effect of arsenical spraying on fruit blossoms. That its effect would be to destroy the blossoms is quite probable. Thus, Mr. James Fletcher has suggested the spraying of the blossoms of pear trees infested with the Pear Midge (*Diplosis pyrivora* Riley) as a remedy for annual attacks of the insect by depriving it of the food (within the young fruit) needed for its development.

There are, then, before the economic entomologist and the fruit-grower at the present time these two questions relating to spraying with the arsenites during the blossoming of fruit trees: First, will the poison kill the bees, destroy the young brood, and affect the honey? Second, will it blight the blossoms? It would not be a difficult task for an experimental station, and it is specially within the province of the stations, to set these questions at rest and no longer leave them subject to crude observations or individual opinions. Until this shall be done, there should be an entire cessation from arsenical spraying of fruit trees while in blossom, without the enactment of laws which now seem premature and may prove to be not needed; and even if seeming to be needed, are still fraught with evil, from the general disregard with which such laws are treated.

It is unnecessary to say that there should be no restriction of the kind, either optional or compulsory, unless it is shown to be absolutely required. The arsenical spraying of fruit trees has already come to be regarded as almost indispensable to the successful fruit-grower, and day by day its importance is being more fully and widely realized. No longer limited to the control of Codling Moth injury, it is being rapidly extended to other insect attacks. For each week of early spring, I have no doubt but that a calendar could be made wherein each day would stand for the incipiency of attack by some insect pest or fungous disease, to be combatted in no better way than by arsenical or copper solutions sprayings. What opportunities may therefore be lost for arresting and defeating attack at the most favorable time, and possibly at its only vulnerable stage, if two or three weeks' armistice is accorded to your enemies, during which time the army is recruited a hundredfold, the infant becomes a veteran, mines are run, pits are dug, tents are built, covered ways are constructed, insidious mycelium threads are permeating leaf and twig, and in many other of the arts of warfare your wily foes, with their rich inheritance of surprising means for self-protection, have planted themselves in strongholds where an entire park of spraying pumps with their baneful poisons will utterly

fail of reaching and destroying them. Far better a cessation of hostilities for any six weeks later in the season than for three in early spring. It has been stated and reiterated many times that the Codling Moth is the only insect against which we need to employ the arsenites in early spring, but this is far from the truth. It is conceded that we can not destroy the Apple Worm until after the fruit is set and the egg deposited thereon, but of the two hundred and eighty known species of insect depredators on the Apple (not referring to those infesting other fruits) it would be strange indeed if there were no others which are specially vulnerable before the setting of the fruit. Let me name a few of those that could be reached at this time:

The well-known Apple-tree Tent-caterpillar of *Clisiocampa americana* Harris, attacks the bursting buds and the young leaves.

The caterpillars of the White-marked Tussock-moth (*Orgyia leucostigma* Sm.-Abb.) hatch from the eggs about the middle of May and commence their destructive work.

Among the cut-worms there are a number of climbing species, four of which have been identified, viz, *Agrotis clandestina* Harris, *A. scandens* Riley, *A. messoria* Harris, and *A. saucia* Hübn., which are known to ascend apple and other fruit trees to feed upon the blossom and leaf-buds and the tender leaves. The odd-looking caterpillar of *Catocala grynea* Cramer, feeds on the foliage of the apple in May, and those of *Catocala ultronia* Hübner are often shaken from plum trees when jarring them for the curculio.

The Canker Worm (*Anisopteryx vernata* Peck) usually appears as the young leaves are pushing from the bud.

The White Eugonia (*Eugonia subsignaria* Hübn.), one of the family of measuring worms, occasionally appears in injurious numbers about the 1st of May.

The Oblique-banded Leaf-roller of *Cacœcia rosaceana* Harris, spins together the young leaves for its shelter.

The Lesser Apple-leaf Folder (*Teras minuta* Rob.) attacks the opening foliage and folds the leaves for its retreat.

The Leaf-crumpler (*Phycis indiginella* Zeller), awakening from its winter's sleep and drawing some of the unfolding leaves together, resumes its feeding.

The destructive Eye-spotted Bud-moth (*Tmetocera ocellana* Schiff.), so injurious in western New York, after its larval hibernation in its half-grown state, makes its formidable attack, first on the buds and afterward on the leaves.

The Apple Bud-worm (*Eccopsis malana* Fernald) creeps at night from its retreat and, after having consumed the terminal buds, feeds upon the leaves.

The Apple-tree Case-bearer (*Coleophora malivorella* Riley) emerges from its peculiar pistol-shaped case in which it has passed the winter, to eat the buds as soon as they begin to swell, and afterwards to skeletonize the leaves.

The Plum Curculio (*Conotrachelus nenuphar* Herbst) enters upon the scene at least two weeks before its first crescent cuts are made in the fruit, ready and free to devote all its energies to obtaining the supply of food needed for the development of its eggs and for the labors attending its complicated and painstaking method of oviposition.

Seventeen species of insects are named above, each one of which is feeding voraciously during the blossoming of our fruit trees. Possibly as many more could be added to the list, all of which could best be destroyed by arsenical spraying.

It is therefore respectfully submitted whether there should be the intermission of spraying as proposed, urged, and sought to be made compulsory through legislation, until it shall appear beyond all controversy that the interests of the agriculturist and the fruit-grower—each carefully considered and perhaps weighed one against the other—really demand it.

In the discussion following, Mr. Webster stated that he had as yet reached no positive opinion as to the poisoning of bees by spraying.

Mr. Garman had observed in one instance a bee alight on a recently sprayed tree and suck up from a leaf a drop of the liquid containing London purple. He had no doubt that thirsty bees did sometimes get in this way some of the poison, but whether it was sufficient to injure them or not was a question requiring investigation.

The Association then adjourned to meet at 2 o'clock p. m.

FIFTH SESSION—AUGUST 16.

The Association was called to order by Vice-President Smith at 2 p. m.

The committee on nominations reported the following officers as its selection for the next meeting:

For President, L. O. Howard, Washington, D. C.
For Vice-President, J. B. Smith, New Brunswick, N. J.
For Second Vice-President, F. L. Harvey, Orono, Me.
For Secretary, C. P. Gillette, Fort Collins, Colo.

On motion the by-laws were suspended and the secretary was instructed to cast the ballot of the Association in favor of these nominations. They were declared elected.

The following paper was then read:

SOME INSECTS OF THE YEAR.

By F. M. Webster, *Wooster, Ohio.*

Epicauta cinerea Forst., *E. vitatta* Fab., *E. pennsylvanica* De G., are all exceedingly abundant in Ohio this year and very destructive.

Crioceris asparagi Linn.—This pest of the garden in its westward march has reach Cleveland and Akron, Ohio, having probably crossed the Alleghanies via the Ohio River and its tributaries.

Systena blanda Mels.—This beetle has proven very destructive to beans in Ohio the present summer. Large fields were seriously damaged.

Euschistus variolarius P. Beauv.—Observed puncturing the skin of ripening tomatoes, numbers being clustered on a single tomato and the juice oozing from the punctures. They also attacked peaches in a similar manner.

Phytonomus punctatus Fab.—This species reached Wooster, Wayne County, Ohio, this year for the first time, adults having been observed on several occasions during June and July. The larvæ fed on white clover, leaving the red clover untouched.

Otiorrhynchus ovatus Linn.—Reared adults from pupæ found in blue-grass sod in June, both being present. Larvæ observed in May.

Macrodactylus subspinosus Fab.—This species was found in the larval stage in great abundance in a field of wheat early in May, distributed among the roots upon which they had clearly been feeding. The same field had produced wheat the preceding year. At the time of examination the roots had many of them been eaten, and the plants above ground were not in thrifty condition.

Epitrix parvula Fab.—The adults worked considerable injury to tobacco in southwestern Ohio by eating numerous holes in the leaves.

Thyridopteryx ephemeræformis Haw.—This has been especially injurious this season in southern Ohio—it does not occur elsewhere in the State—and I have nothing new to record except that about North Bend it is parasitized to a limited extent by a Dipteron, probably a Tachinid, as I have found the pupa protruding from the lower or posterior end of the sack and somewhat resembling the anterior end of the pupa of the male Thyridopteryx, as the latter is first pushed forth, preparatory to the emerging of the imago.

The following paper was then read:

INSECTS OF THE YEAR IN NEW JERSEY.

By JOHN. B. SMITH, *New Brunswick, N. J.*

It was with a considerable amount of curiosity that I looked forward to the opening of the season of 1893. The unusual character of the winter, the bitter and prolonged cold, without any real open spell, led me to expect surprises. There seemed to be among farmers a very general opinion that the cold winter had killed off a very great proportion of species, and that probably there would be little or no trouble. My own experience had led me to believe the contrary, and I was curious to see which would prove most nearly correct. As a matter of fact both parties were right; that is to say, some insects were undoubtedly very greatly cut by the severe winter, while others on the contrary hibernated unusually well. Most of the common pests made their appearance in their normal abundance, and some indeed were considerably in excess; as, for instance, the Elm Leaf Beetle, which I do not remember ever to have seen in anything like the numbers in which it made its appearance this spring. A number of others of the common species did equally well, while on the contrary others seem to have been very greatly reduced in numbers. In the melon fields, in which I made observations as soon as there were melons to be observed, the striped beetles *Diabrotica vittata* were in most localities very much fewer than I have ever known them. Only in sheltered places, near the edges of woods or shrubbery, or near barns or other buildings, wasthere much injury. The Boreal Lady Bird (*Epilachna borealis*), which for several years past has increased steadily in numbers, was this season to be counted among the rarities; only here and there was a specimen to be found where in the two previous years hundreds could have been taken. The common Squash Bug (*Anasa tristis*), was also notable by its diminished numbers. Only here and there could a specimen be found, and egg clusters, usually so prominent everywhere through the fields, were this time few and far between. Of the melon lice, which two years ago were in such an enormous abundance, I have not yet found trace in any part of the State. I made diligent and faithful search, not only in the melon fields, but on all kinds and descriptions of plants in their vicinity, and studied closely every specimen of louse that at all resembled those that I was seeking. To the courtesy of Mr. Walker, of Jamaica, Long Island, I owed a considerable number of cocoons of the Squash Borer. Those I kept in a breeding cage in my laboratory, looking after them from time to time to note the date of pupation. Not until spring was well advanced did any of the larvæ pupate; that is to say, they remained in their cocoons in the larva state throughout the winter, and did not pupate until a short time before they were ready to transform

into moths. The first specimen made its appearance in my breeding cage May 15; others, one at a time, appeared until June 1, on which day I had 7 imagos. At that time I cut open a considerable number of the cocoons and carefully emptied out the box of moss in which they had been kept. I found several pupæ making their way up to the surface, and found in the cocoons a number that had just transformed. Found also, in others, a very fair proportion of larvæ that as yet showed no signs of changing. Specimens continued to issue throughout June, the last specimens which I recorded making their appearance early in July. It is very likely that in nature the time of the appearance of the insects is equally spread out, making it a yet more difficult one to deal with. It is not likely, however, that in the open, many specimens will issue quite as early as they began to issue in my laboratory. From what I have observed, the insects wintered in the field just about as well as they did with me, and I have already heard from several localities that the borers were out in force.

Cutworms also wintered remarkably well, except on those farms in which the commercial fertilizers were used. There was a very great difficulty in getting a stand of a considerable number of crops. Melons, sweet potatoes, and corn were cut with great severity, and replanting of all of these crops had to be done; in some cases as many as three or even four times. Corn, in fact, was an unusual sufferer in New Jersey this year. The "Bill Bug" did not make its appearance at all, so far as I have heard, even in those localities in which it was very much the worst last year; but on the other hand there was an enormous increase of injury done by the "Corn-root Web-worm," the larva of a species of Crambus which I have not attempted to bring to maturity. This insect has in some cases made replanting necessary over large areas, and even now, at the present time, there are fields in which these insects can be found in considerable numbers, and in which the corn is a very irregular and unsatisfactory stand. These web worms are very much the worst on old sod land, where they probably infested the grasses in previous years, and this insect too is almost entirely absent on these farms on which the commercial fertilizers are used to the practical exclusion to barn yard manure. In fact this more than any previous year has emphasized the exemption enjoyed by those farmers who habitually used the mineral fertilizers. Besides this web-worm, seed corn, or the young corn plants were also attacked by a Span Worm, the larva of a Geometrid. This was sent me by Mr. Crane, of Caldwell, who is trying to bring it to maturity. The larva is a very strongly marked one, and he says that he feels certain that he has seen it in previous years in the stalks of Dahlia and in Pigweed. An Anthomyiid larva was also injurious locally. The Anthomyiid was bred; but has not been specifically determined. A feature in some parts of southern New Jersey was an invasion by a Flea Beetle, *Systena blanda*. This insect I had never previously found in anything

like troublesome numbers; but this time for some reason they were present in countless numbers. In Monmouth and Cumberland counties carrots were almost entirely destroyed by them. The fields were attacked when the young plants had just made their appearance above ground, and were eaten off so completely that in the course of two or three days nothing was left on the ground. Young beets were then attacked, but not so generally as were the carrots. The insects manifested a very catholic disposition so far as their food was concerned, and ate almost everything that came to hand. Melons of all kinds, grown in some places, had the leaves riddled by them, while every plant of Pigweed bore a dozen or more specimens; in fact Pigweed seemed to have been a very great favorite, and in some cases even these plants were killed by the attacks of the insects. The attack was over, however, in two or three weeks, and since that time few of the insects have been seen. I have made no attempt to work out the life history of the insects, as I have been under the impression that it has been already worked out, or was being studied by Mr. Bruner.

Another insect that stood the winter remarkably well was the Sweet-potato Flea-beetle, *Chœtocnema confinis.* This made its appearance in perfectly enormous numbers in Gloucester and part of Salem counties, fairly riddling the leaves with its peculiar channels. The insect does not seem to spread very much; but I have found specimens of its work on the Bind-weed in Cumberland County. It is more than probable that this Bind-weed is really the ordinary food plant of the insect, and that from this it has come to sweet potato. I have been again unsuccessful in getting at the early stages of this species with any degree of certainty, though I am now convinced that the larva of the insect lives in the small rootlets which are so abundant on the sweet potato plant. I have noticed in a number of cases of plants that have been badly infested by the beetles early in the spring, that about three weeks later a great many of these small rootlets had been apparently eaten out. I did not find any larvæ, but hardly know to what else this injury could be attributed: there is certainly no other part of the plant that nourishes the larvæ. I kept a large number of specimens of the beetle in confinement for about two weeks in a jar containing growing plants; but failed to obtain upon them either eggs or larvæ, although the beetles copulated freely in confinement. One fact I have learned through the Philadelphia collectors, and that is, that the beetles again make their appearance in July and August, and that they hibernate as adults. Specimens have been sifted out by Mr. Wenzel from material collected in January. This explains also why insects are always first seen at the edges of fields adjoining roads, fences, and especially woodlands.

One of the unexpected occurrences of the season was the abnormal increase of the "Wheat-head Army-worm," the larva of *Leucania albilinea.* In two or three counties of the State north of Trenton and

along Delaware it did a very considerable amount of injury, making its appearance just as the grain was ripening. This is one of those creatures against which we are more or less helpless, and the only advice that I was able to give to the farmers was to harvest the wheat just as soon as they possibly could. The advice was followed very generally, and a conservative estimate placed the damage done at about 10 per cent of the amount of the crop. A very large proportion of these larvæ were parasitized, principally by a Tachinid; but the fact that so large a proportion was parasitized did not, so far as I have been able to ascertain, lessen the injuries sustained by the farmers in the least. I have been puzzled to know what peculiar local condition caused the sudden increase of this species. It is something which the farmers themselves say they had never seen before; but this of course means nothing, for I know that the moth is one of those that is moderately common every year. In other parts of the State where the moth is equally common there was no unusual increase.

Raising onions for seed, for sets, and for market, is quite an industry in Cumberland County, and heretofore nothing in the way of insects has troubled the crop. One of the largest growers in that county, and at the same time one of the best farmers in the State, had familiarized himself with the insects that were elsewhere most troublesome, and had been keeping a very close lookout for the onion maggot, which was known to be injurious in other portions of the State. In May he wrote me that he had found a very considerable percentage of the sets planted for bulbs to be infested by the maggots, and that not he alone, but his neighbors as well, suffered equally. He asked an explanation of how this insect could have appeared in such numbers, and over such an extent of country, when it had not been previously known anywhere in the vicinity. Of course I failed to answer the question, since I could only suggest that probably the insect had been present in the vicinity in small numbers, and had not been noticed; but had found unusually favorable conditions for its increase during the present year. Heroic remedies were at once adopted; plants were taken out where they showed signs of attack and were destroyed; in addition to that the soil was turned away from the tubers, kainit, at the rate of 500 pounds to an acre, was applied, and the soil turned back again to the rows. Two weeks later when I visited at the field, no trace of the onion maggots could be found; nor did they again make their appearance at any time later, or up to the present time.

It is rather a remarkable fact that not only the insects should have made their appearance in such numbers where they had not been known previously, but also that they should have been so completely destroyed by the measures adopted. There was one fortunate circumstance connected with the outbreak, and that is that all the onion-growers in the vicinity were intelligent men, who fully appreciated the danger, and who did not hesitate a moment in adopting the remedies

suggested. Another insect which I had not previously noticed was also unusally abundant in the onion patches. I refer to a small yellow Thrips, which was present in countless numbers on the leaves of the plants, sucking the juices; or more correctly, perhaps, scraping small portions of the outer skin, which became yellow-spotted. In a great many fields the insects were so abundant, and these yellow spots so close together, that practically the leaves were killed. This was aided by the fact that in this region there was an excessively severe drought, which checked the growth of the onions and prevented their recovering from the effects of the injury. Before the middle of July these insects had practically disappeared. It is probable that this insect has been present previously, but that the onions, in ordinary seasons, are able to withstand the drain without trouble. About the time that the bulbs were matured, a bacterial disease made its appearance here and there in the field, and these bulbs, even when only slightly affected, were covered with innumerable quantities of mites. I have, as yet, made no attempt to ascertain the species, and know nothing about the creature, except that it is white, and has chestnut-colored legs. Besides mites, certain fly larvæ also attacked these onions, and these were at first supposed to be onion maggots. As soon as I found egg-masses, however, I realized that there was probably an error, because the eggs were beautifully ribbed, which, I believe, is not a characteristic of Anthomyiid eggs. I succeeded in breeding a considerable number of the flies, and find that it is a species belonging to the *Ortalidæ* or *Trypetidæ*. I have seen the flies only in the breeding jar, and therefore can not give any more definite information concerning them. I bred also, from other onions, two or three species belonging to the Muscids, which are also yet in the breeding jar, and have not been examined with the view of identifying them.

The Strawberry Weevil (*Anthonomus signatus*) was troublesome in a few localities in southern New Jersey; but did not injure any very large proportion of the crop. I did not learn of the appearance of the insect until it was too late to make personal investigations, hence depended upon hearsay for estimates of injury caused.

The Twelve-spotted Asparagus-beetle (*Crioceris 12-punctata*) was again found in considerable numbers in Gloucester County, where I had taken it last year. It was also taken by me much further south in Cumberland County, and was taken by the Philadelphia collectors near Camden. The insect thus has covered a considerable proportion, embracing nearly the whole of the sandy plains, of the State; even where it was most abundant, however, it is in no sense a rival to the older *C. asparagi*. I found this year one of the growers practicing a method of destroying the larvæ in his young plantations which had the merit of extreme simplicity, combined with the utmost effectiveness. He simply went over the entire patch in the middle of the day with a long stick, with which the plants were gently brushed in such

a way as to dislodge the feeding larvæ. They dropped quite readily, and as I followed him along the rows I found that a very small percentage only of the larvæ remained upon the plants. Those that were knocked off on the burning hot sand died in a very few minutes, and none of them ever found their way back upon the plants. This is not surprising, because in the middle of a warm day the sand becomes so hot as to be almost unbearable to the touch, and these soft insects when thrown upon it died within a very short time. This process would have to be repeated only a very few times in the course of the season to keep the plants entirely free. This method is useful, of course, only in young beds; but in the older beds which are cut regularly the insects can be kept down without any trouble, either by close cutting or by means of trap shoots. We are able thus to control this species, which only a few years ago seemed to threaten the asparagus industry in some parts of New Jersey.

The Pear Midge has been spreading in the State; but very slowly. I found it this year in Monmouth County, further south than it had been in previous seasons, and present only in very small numbers, in the Lawrence pears. Near New Brunswick, in the orchard in which I first discovered the insect, the Lawrence had made an excessively heavy set of fruit, and in the entire orchard there was not a single pear of this variety which was not infested by these midges. Some other orchards near by, which last year had not been attacked, were also seriously injured this season. On the other hand, in an orchard in which last year there were a considerable number on this variety there were fewer than there were in 1892. This is to be accounted for by the fact that on my recommendation the owner of the orchard plowed the ground under his trees in fall, and applied kainit at the rate of 1,000 pounds to the acre. The result is that this year he is practically free from the pest, even though his orchard adjoins the one previously mentioned, in which every solitary pear was full of midge larvæ. I succeeded in inducing the owner of this infested orchard to permit the trees to be entirely stripped of fruit, and I hope that in this way some protection against the spread of the insects will be afforded. I am unable to say positively, of course, that it was the kainit which prevented the appearance of the midges where it was applied; but I have now under way a series of experiments which will, I hope, give some definite information on this subject.

Altogether the season has not been an unfavorable one in our State so far as insect injury is concerned. I am extremely pleased to be able to say that in most localities the better class of farmers, those that make money by farming, are ready to adopt any reasonable methods suggested by the station for the control of insects and other pests, and I believe that there are few States where the farmers have learned to trust the station officials as thoroughly as they have in New Jersey. There is perhaps no other State in which the station workers are so generally acquainted with the farmers of all sections.

The following paper was then read:

NOTE ON SOME OF THE MORE IMPORTANT INSECTS OF THE SEASON.

By Herbert Osborn, *Ames, Iowa.*

The present season has so far been marked by a rather exceptional abundance of several common pests. During the fore part of the summer the Clover Hay-worm (*Asopia costalis*) attracted considerable attention, many of the larvæ and specimens of their work being sent to me from different parts of the State. It would seem that the species has been increasing rapidly along with the increase of clover hay put up in this region. In some cases the injury has been caused by *Asopia farinalis*, although from many of the specimens *Asopia costalis* has been bred.

The Wheat-head Army-worm (*Leucania albilinea*) has also attracted considerable attention, causing serious losses to timothy seed crop, but its distribution has been different from what it has usually been in the State. This season the injuries reported have been mainly in the northeast quarter, and but few reports and probably less injury has occurred in other sections. Formerly its greatest damage has been known in the southeast quarter.

The Potato-stalk Weevil (*Trichobaris trinotata*) has been, if anything, more common and destructive than before and is probably to be credited with considerable injury to potatoes that has been assigned to other causes or referred to dryness.

Several species of Acriididæ have been very plentiful and their injuries much more noticeable than in ordinary seasons. *Melanoplus femur rubrum* has been the most abundant species, but *differentialis* and *bivittata* have been unusally common and other species of the family have also been present in abundance. Pastures and meadows have suffered from their great numbers and they are affecting cabbages and other garden plants and have also completely stripped a number of apple and other orchard trees, a phase of injury which I have never before observed at Ames.

The Horn Fly, which has been rapidly spreading over the country, has appeared in large numbers at Ames this season and is proving quite troublesome to cattle.

In discussing these three papers Mr. Riley remarked that the arsenical poisoning for the Blister Beetles was effective so far as killing the beetles was concerned, but that the difficulty in the case was that they continued to come from day to day. In large potato fields the driving and burning methods have proved at times quite effectual, but during years when the insects are very numerous it is almost impossible to protect given plants or smaller areas. He had found this to his

sorrow in trying to protect certain choice clematis plants in his own garden during the past two years. A succession of species would continue their defoliation, notwithstanding all methods of destruction.

The following paper was then read:

ICERYA PURCHASI AND VEDALIA CARDINALIS IN NEW ZEALAND.

By R. ALLAN WIGHT, *Auckland, New Zealand.*

[Read, in the author's absence, by H. Osborn.]

The course which these two insects have run in New Zealand, although remarkable, is perhaps very similar to the experience of other countries, but there are some circumstances which appear to be very extraordinary and not too easy to understand. The Iceryæ were first seen in a small group in Auckland, and looked upon as a harmless curiosity. Dr. Purchase, an Auckland divine and physician, sent specimens to Mr. Maskell, who gave the insect the specific name of *purchasi*, for, although it had long been known to Australian entomologists, it had always been considered as identical with *Icerya sacchari*. It spread with wonderful rapidity, till every green thing seemed covered with it, when suddenly it received a check and as rapidly disappeared, as if by magic, and, strange to say, not one person in Auckland had noticed the Vedalia that destroyed it or had the least idea that such a beetle was in existence, incredible as it may seem. Mr. Koebele was the first man to discover the beetle and its action in Australia, and another person was the first to do the same in Wairoa South in New Zealand, but it was a close run, for Mr. Koebele was then at Napier, where he procured the bulk of his Vedalia. Perhaps the most singular circumstance connected with the arrival of Icerya in New Zealand is the fact that, although both insects were undoubtedly imported from Australia, those which were introduced upon imported plants were the exceptions to the rule. In several districts, where the matter was properly observed, it was found that the nurseries with imported acacias and citrus plants were not the places first infected, but the acacia hedges, which had been grown years ago from seed, and the patches of gorse, self-sown, and far away from cultivation and imported plants. This occurred not in one district only, but in several.

An interesting fact, which may now be considered fully proved, is that, when Vedalia has completely cleared a district of Icerya, and has itself apparently completely died out, Icerya will return in force after awhile, and Vedalia will also revive and again destroy it. The last instance of this has occurred at Napier, in May. Both insects have

now, for some years, been looked upon as extinct at Napier, but Icerya having appeared at Wellington (the capital), the government have directed Mr. Wight to procure the inevitable *Vedalia cardinalis*, and he finds that it is to be had again at Napier in such numbers that, to use Mr. Commissioner Harding's expression, as many can now be procured by a good collector as Mr. Koebele obtained, in the same time. Mr. Koebele caught 6,000 in three days, and, even considering that Mr. Koebele is a most exceptionally good collector, there does not seem much fear of the useful little insects becoming extinct. A very long experience, and much close observation of these two insects, enabled Mr. Wight to observe some interesting and useful facts connected with them. On one occasion, when he was engaged for several weeks among them, collecting and taking notes, he found a wide, straggling hedge of *Acacia undulata*, several miles long, at one end of which a very few Vedalia had been introduced and had increased at a rate that he would not like to ask anyone to believe. Where they had first been liberated all the scales were gone and all the ovisacs empty; in some cases the mother scale had died naturally and the young larvæ escaped, but nearer, where the invading army had swept on, it was observable that in nearly every ovisac which had been plundered there still remained a very few of the eggs, these being invariably situated under the body of the scale mother, and, instead of being merely covered by the cottony ovisac, were imbedded in the fluff. These eggs being spared accounts for the survival of the pest, and the reason of their being spared was afterwards explained when some hungry Vedalia were offered Dactylopius scales and could not eat them because the fluff entangled their jaws. It was also observed that where there were patches of untouched ovisacs the female Vedalia laid eggs, either touching the terminal portion of the covering or slightly lifted it and inserted them under it. The idea occurred to Mr. Wight that in this way the Vedalia had most probably been introduced naturally into New Zealand, and, acting upon it, he collected some of these impregnated ovisacs (a tedious process), and also increased the number by confining impregnated female beetles, and tried the experiment of shipping them to the Cape of Good Hope, where they fortunately arrived alive and had the honor of being the first live Vedalia introduced into that country (April, 1892). The circumstance is mentioned here, as it may be a useful hint to the entomologists wishing to send live Vedalia to a great distance, in a hot climate, which is not a very easy thing to do successfully.

This paper was briefly discussed by Mr. Riley.

The following paper was then read:

NOTES ON SOME INSECT PESTS OF TRINIDAD, BRITISH WEST INDIES.

By F. W. Urich, *Trinidad*.

[Read, in the author's absence, by J. B. Smith.]

In treating of the insect pests of Trinidad we must divide them into two groups, viz: The garden pests, which make themselves felt principally during the dry season (January to April), and the agricultural pests, which are more numerous during the rainy season, which is so conducive to the development of insects. In fact, an entomologist's season lasts as long as it rains, which in Trinidad is from May or June to December, and sometimes longer. With the luxuriant vegetation we have here, unless the insect attacks are very severe they do not seem to attract any attention from the inhabitants. This apathy is most detrimental to our gardens, for the constitutions of many valuable plants are weakened and they fall easy victims the minute the pests get the upper hand.

For the names of most of the insects referred to I am indebted to Prof. C. V. Riley. Mr. T. D. A. Cockerell kindly gave me the names of the Coccidæ.

Amongst the garden pests the Coccidæ are most conspicuous, and seem to thrive best during the dry season. I have collected about twenty species, all from different gardens about Port of Spain and St. Anns, a description of which will be published elsewhere by Mr. T. D. A. Cockerell, and no doubt some more will turn up in the course of time. The commonest Coccid in the gardens is the *Orthesia insignis* Dgl. which seems to have a great liking for Crotons, Eranthemum, and other decorative foliage plants. I do not think that I shall be making a bold assertion in saying that there is hardly a garden in this island in which this insect does not occur. A *Lecanium* sp. found principally on Hibiscus and *Lecanium hemisphæricum*, are also pretty common about the gardens, doing considerable damage. The following genera of Coccidæ are represented about the gardens sometimes by several species:

Aspidiotus.	*Vinsonia.*
Asterolecanium.	*Ischnaspis.*
Chionaspis.	*Pinnaspis.*
Lecanium.	*Orthesia.*
Mytilaspis.	*Icerya.*
Pulvinaria.	*Planchonia.*

As far as the other genera of the Hemiptera are concerned *Siphonophora* sp. ? near *glauca*, Buckley and an *Aphis* sp. are well represented, but seem to disappear as soon as the rainy season sets in. *Cerataphis lataniæ* is not very rare and spoils many a pretty palm about the gardens. A Tingitid, *Corythuca* near *ciliata*, also found on the castor bean, seems to have a liking for Dahlias, leaves of which plant it soon

causes to wither. All these garden pests are well kept in check by their natural enemies, many of which can be seen on the different plants. There are many *Brachyacantha ursina* and allied species, and the black carcasses of the Aphides with a small hole at one end of their bodies tell us that the *Ephedrus incompletus* Prov. has found them fit subjects for depositing their eggs in. The Coccidæ also show parasite holes on their scales. A *Chrysopa* sp. is quite common here and is always found together with the *Orthesia* on Crotons.

In our garden at Port of Spain we keep a little Cyprinodonte? sp. about 1 inch in length. This little fish is found commonly all over the island and I am sending specimens to Prof. C. V. Riley to show to the members of the Association. His use is to keep down the mosquito larvæ in the water tanks, etc. I think this little fish could be introduced into America with comparatively little trouble, as he is very hardy, standing a degree of heat which would kill most fishes; besides this it is viviparous, so that a few put into a water tank would increase without giving any trouble at all.

Amongst the agricultural pests the first place is taken by the leaf-cutting ants (*Atta sexdens* L.), which is the worst enemy of the cocoa plantations. It is found all over the island. The average size of a colony of these ants is 1 cubic foot. A nest, as it may be called, consists of a number of these colonies near each other, and connected by subterranean galleries. The largest nest I have seen covered an area of about 2,500 square feet, and must have contained hundreds of colonies, each of which possessed a queen. The colonies produce hundreds of females yearly, which, as soon as the rainy season sets in (about May and June), swarm, and a certain proportion of them form new colonies. The damage these ants do to young cocoa trees is a source of perpetual anxiety to the planters, who spend large sums yearly to have the nests destroyed. The method adopted to destroy these ants consists in "puddling" them, to use the local expression. This process consists in digging up the nests, adding plenty of water, and then mixing up the ants with the mud, so as to stifle them, and form a concrete mass. There are some other remedies used, such as coal tar and cyanide of potassium, but they are not attended with good results.

A Longicorn beetle (*Stirastoma depressum*) also attacks the cocoa trees, preferring the young ones. In some localities it is on the increase. The tree this beetle attacks in the woods by preference is the *Pachira aquatica.*

Generally, every year at about the commencement of the rainy season, swarms of locusts, belonging to the Acridiidæ, suddenly make their appearance, and commence attacking the cultivations. The fact of the insects being all young tends to show that they are hatched from eggs of the year before. They are generally destroyed, so that the numbers are well kept in check.

At the present moment the Coccid, *Diaspis boisduvallii*, is making its

presence felt at Cedros (south coast of Trinidad) in the cocoanut estates. There are about 20 acres, equal to about 1,400 trees, attacked. At the same time the Palm Weevil (*Rhynchophorus palmarum* Linn.) has made its appearance there, up to now in few numbers, but it may increase in time. It is likely that the Coccids are the cause of the weevils' attacks, for, as far as my experience goes, this beetle likes diseased trees.

The cane-borer, *Xyleborus perforans*, which caused so much damage to the sugar planters last year, has not done any damage to speak of this year, although it has not disappeared from the cane-fields altogether, and might increase in numbers as soon as favorable conditions occur.

In concluding these brief notes I would like to call attention to the good services the hunting ants, Eciton, render the Trinidad agriculturists. Up to the present I have observed two species in Trinidad, the most conspicuous of which is *Eciton Forelii* Mayr. Most travelers in tropical regions represent this ant as a most ferocious insect, not even sparing man. The good they do to cocoa estates in clearing away vermin is invaluable, for they are the sworn enemies of everything which creeps and crawls, and which they tear to pieces and devour without mercy, but they do not attack man if he is not the aggressor, as will be seen from the following lines taken from a letter received from Mr. A. B. Carr, of Caparo:

"The other night I was suddenly awakened by something crawling over my face. Catching some insect I crushed it, and from the smell it emitted I knew at once that it was a hunting ant. At the same time I heard the peculiar clicking noise the hundreds of legs make when hurrying about in quest of food. Although it was not quite convenient, I left the house and sought shelter at a neighbor's, knowing well that all vermin would be soon cleared out. It is remarkable that they did not attack me while asleep, although when we interrupt their columns in the woods we are furiously attacked. It is a pity that these ants do not usually attack large nests of the Atta, although I have already seen them plundering a small colony."

The following paper was then read:

NOTE ON SLIP-RECORDS.

By T. D. A. Cockerell, *Las Cruces, N. Mex.*

[Read, in the author's absence, by H. Garman.]

It has occurred to me that the present is a suitable occasion for bringing forward a suggestion, which I have long intended to make, as to slip-records.

Every entomologist in the course of his work makes numerous notes on which he bases his published papers. But when he dies, or gives

up the study of entomology, he usually leaves a considerable amount of fragmentary unpublished matter, which is very likely to be wasted. If he has been a careful worker, he is sure to have made descriptions of larvæ which he could not rear, incomplete notes on habits, distribution, etc., and other observations which are valuable and yet too incomplete for publication. He will also have made many notes which could hardly be published as separate items, and yet would be very useful in the preparation of faunal or monographic works. He will probably have hoped to make use of all these notes in publication himself, sooner or later, but he is exceptional if he can complete his projected labors before he dies.

The great difficulty of dealing with the scattered manuscripts of a deceased naturalist, unless he has been unusually methodical, has often been alluded to by writers; and the suggestion I have to make is that in future, so far as possible, entomological notes be kept on a uniform plan, so as to make it easy to preserve and consult them, and to incorporate notes by various authors in a single series.

In order to do this, we can hardly adopt a better method than that of slip-records. The slips should be of uniform size, although the paper or card they are made of may vary according to the taste of the individual. For myself, I prefer paper to card, as being both cheaper and less weighty to carry about. But the point of importance is the size, as the essence of the scheme now proposed is that all notes should be capable of being incorporated in a single series, or notes from various authors on a single subject in a series. I inclose herewith a slip of the kind used by Mr. C. D. Sherborn in his great index of the genera and species of animals, now in progress at the Natural History Museum in London. Both as to size and paper it seems to me very suitable, and slips of this sort are extremely cheap.

I therefore suggest to this association that all slip-records be kept on slips $2\frac{1}{2}$ x 5 inches.

Now, as to the manner of writing the notes, the inclosed specimen shows the method I have adopted.

When a specimen is entered it receives a number—in the present case 178. Before the number I write "Ckll.," being an abbreviation of the recorder's name. Each recorder should adopt an abbreviation of his name which can be easily recognized, or else write his name in full before the number, so that when his notes are incorporated with others there may be no mistake as to who wrote them.

After the number follows locality, date, and any necessary particulars.

Two species should never be put on one note, unless it is a reference to a second species in connection with that to which the note refers, as *Lycæna marina* in the note sent.

When the notes are written they should be kept in a series, according to their numbers, until the names of the species are ascertained. When

a species is identified the name is written in a space left at the top of the note, and the note is transferred to its place (in alphabetical order) in the group to which it belongs. The name of the authority for the identification of the species should appear in square brackets after the name of the nomenclator, thus, in the note sent: *Monedula pulchella*, Cr. [Fox].

Not rarely it is necessary to use large sheets of paper for extended notes, and especially drawings. These should be preserved separately and indexed by notes of the usual kind placed in the regular series.

Had this method been pursued in the past we might have been able to consult in one series, in a public museum or library, the notes of Say, Harris, Fitch, Leconte, and many others. Imagine the value and interest of such a collection! Imagine the numerous little facts, hints, and suggestions they might have left us which are nowhere to be found in their published writings! And if the notes contained nothing that was not published, how great the advantage of a complete index to their voluminous writings! Such a collection of slip-records would be one of the most valuable possessions of a public library or museum, and care would have to be taken that it was used with discretion and preserved intact.

I have alluded to this method as offering a means of preserving conveniently the manuscripts of those who die; but it has great value during the lifetime of the recorder. I had such a slip-index in Jamaica, and found it so useful that I would never now be without one. I left it in the Jamaica Museum for my successor, and have commenced a new series for the New Mexico Agricultural College.

Further, it permits the ready tranference of records. I often receive (and, I trust, send) valuable bits of information in letters. All this I have to copy out on slips; but what a saving of labor to all parties if it was *sent* on slips, which could be incorporated in the series just as received! Moreover, suppose an author of repute is preparing a monograph. We are all delighted to help him by transmitting our observations on his group, but often the labor of copying them out is very great. By the slip method, we could just send him our slips; he could put them in his series until the monograph was done, and then, if desired, return them to their owners. Therefore, I commend this matter of slip-records to your consideration, and urge you to decide what should be done about it.

Mr. Hopkins, in the discussion following this paper, said he used the system advocated in the paper; that he kept a box of the slips constantly on his table, but that he preferred a larger slip as holding more and as affording room for sketches.

Mr. Summers suggested the standard library card as preferable to that used by Mr. Cockerell.

Mr. Osborn agreed with Mr. Summers.

The association then, on resolution, adjourned to meet at such time and place as may be decided upon by the executive officers.

H. Garman,
Secretary.

DIPTEROUS PARASITES IN THEIR RELATION TO ECONOMIC ENTOMOLOGY.*

By C. H. Tyler Townsend, *Kingston, Jamaica.*

It is a patent fact that no insect parasites of insects occur in the large series of orders known as the Ametabola, or those with an incomplete metamorphosis. They are to be found only in the series Metabola, or those orders which undergo a complete metamorphosis, and within this series they are confined to three orders. Certain predatory forms occur in the Neuroptera (as restricted) and the Lepidoptera, but the only orders containing true parasites of insects are the Coleoptera, Hymenoptera, and Diptera. It is, therefore, evident that parasitism on insects is a perquisite of the higher and more developed orders, and usually, within these orders, of the higher and more specialized groups. Moreover, the higher the order, the greater is the percentage of parasitism which it contains. The Coleoptera contains an extremely small percentage, belonging to about four small families. The Hymenoptera contains a large percentage, distributed, however, through but a half dozen or so of families, and comprising mostly very small parasites. The Diptera contains probably the greatest percentage, distributed through about seventeen families.

Still another point remains to be noticed, and that is the diversity of the parasitism, or the number of orders upon which each of the three named is parasitic. Of the sixteen orders of insects, as evolved by Brauer and now generally accepted, only five are subject to parasitism. These are the Orthoptera, Hemiptera, Coleoptera, Lepidoptera, and Hymenoptera. The parasitic Coleoptera are confined in their attacks to the first and last of these. The Hymenoptera attack the last four, including their own order. The Diptera, however, furnish parasites upon all five of these orders.

Last of all, two significant facts strike us: First, that the Diptera themselves are not attacked by any parasites, not even by members of their own order, if we may except a species of Phora which is said to destroy the larvæ of the Silk-worm Tachinid in India. There is no reason, however, for believing that this is a true parasite. While the Coleoptera are subject to parasitism from the Hymenoptera and Diptera, the Hymenoptera are subject to attack from all three (including

*This paper reached me too late for presentation at the Madison meeting.—H. G.

their own order), but the Diptera are exempt, at least it is safe to say comparatively so, from true parasitic attack. The second and final significant fact is that the Diptera are the only order of insects which has become truly parasitic (endoparasitic) on mammals, including man himself. This fact of the dipterous parasitism on Mammalia seems the most remarkable and striking of all.

Of these three parasitic orders, our subject deals with the last named, the Diptera, and more particularly with the parasitic members of the order in their economic relations. It has been noted that the Diptera afford the most generally distributed amount of parasitism, covering the entire field of orders subject to parasitic attack. Let us separately consider the families of Diptera which contain parasitic members.

(1) *Cecidomyiidæ.*—A number of cecidomyians are known to be parasitic on Coccidæ and Aphides. Prof. J. H. Comstock found a Diplosis in California parasitic on Coccids. Mr. T. D. A. Cockerell has found a similar parasitic species in Jamaica. A number of other cases had been previously recorded, and they apparently all belong to the genus Diplosis, though one is referred to Cecidomyia. The parasitism in this family, comprising as it does the only cases in the Nemocerous Diptera, is extremely interesting, since the Nemocera are the most ancient living forms of Diptera. It should be noted also that the parasitism here is confined to a few members of a single genus. About eight North American genera are known, some being very numerous in species.

(2) *Nemestrinidæ.*—Two North American genera are known. The genus Hirmoneura is recorded as parasitic on wood-boring coleopterous larvæ. A European species is said to deposit its eggs in the burrows of a buprestid, to which the larvæ attach themselves by means of hooks on the segments, but later lose the hooks and become parasitic on a secondary host, a beetle of the genus Rhizotrogus.

(3) *Bombyliidæ.*—In this family over thirty North American genera occur. These flies are all, so far as known, parasitic on insects of the orders Lepidoptera and Hymenoptera. There is only the exception that the larvæ of Aphœbantus and Systœchus have been found to feed on the eggs of locusts. It is the peculiar habit of this family to attack insects which live underground, such as certain bees and wasps, and cutworms.

(4) *Acroceridæ.*—About eight North American genera are known, The larvæ are, so far as known, parasitic on spiders and their egg-masses. It is worthy of note that this is the only dipterous family parasitic on spiders.

(5) *Conopidæ.*—This is another family which contains purely parasitic species. Seven North American genera occur. All are parasitic, without known exception, upon Hymenoptera and Orthoptera, principally upon bees and wasps, whose appearance they have acquired.

(6) *Pipunculidæ.*—The larvæ of some species of the single genus Pipunculus are known to be parasitic on homopterous insects of the family Jassidæ.

(7) *Oestridæ.*—None of these flies attack insects or any invertebrates, but are without exception parasitic on mammals. They are of much economic importance, but unlike the other families of parasitic Diptera, they are highly injurious on account of the hosts which they infest. Nearly all of our domestic animals, and man himself, are liable to their attack. Seven North American genera are known.

(8) *Phasiidæ.*—Seven North American genera are known. All are parasitic, without known exception, on Orthoptera, Hemiptera, and Coleoptera (locusts, Pentatomids, Coreids, and a beetle).

(9) *Gymnosomatidæ.*—Two genera occur in North America. They are parasitic on Hemiptera and Lepidoptera. The species attack Pentatomids, and Cistogaster has been bred from Leucania.

(10) *Ocypteridæ.*—Seven genera are known in North America. They are parasitic, so far as known, on Orthoptera, Hemiptera, Coleoptera, and Lepidoptera (locusts, Pentatoma, Cassida, Leucania).

(11) *Phaniidæ.*—Two North American genera occur. So far, they have been found parasitic only on Coleoptera.

(12) *Tachinidæ* s. str.—Over one hundred and twenty genera are known in North America. These, without any known exception, are all parasitic on insects of the orders Orthoptera, Coleoptera, Lepidoptera, Hymenoptera, but more particularly on Lepidopterous larvæ. This family is preëminently parasitic on Lepidopterous larvæ. Hundreds of species exist, which destroy immense numbers of them annually. The Tachinidæ, from this fact, are perhaps the most important group of beneficial insects which exists.

(13) *Dexiidæ.*—Over forty North America genera are known. These are parasitic, so far as recorded, on Orthoptera, Coleoptera, and Lepidoptera. A Dexiid has also been bred from a scorpion, and from snails.

(14) *Sarcophagidæ.*—About seven genera are known in North America. The Sarcophagids are largely creophagous, and also coprophagous, but some species are occasionally parasitic on Orthoptera, Coleoptera, and Lepidoptera. Phrissopoda has been bred from Lepidopterous larvæ, and from snails. Sarcophaga has been bred from all three orders. Sarcophaga has likewise been bred from snails, and a species is also parasitic beneath the skin of turtles.

(15) *Muscidæ* s. str.—About sixteen North American genera are known. These flies are largely coprophagous and creophagous, but some species have been bred from lepidopterous larvæ. A Lucilia has been found parasitic on toads.

(16) *Anthomyiidæ.*—Twenty-one North American genera occur. Some species are occasionally parasitic on Orthoptera, and some other insects.

(17) *Ochthiphilidæ.*—So far as known, these acalyptrate Muscids, of which there are two genera in North America (one introduced from Australia) are parasitic on Aphids and Coccids. It is noteworthy that the Cecidomyiidæ and this family furnish the only parasites of Aphids and Coccids among the Diptera.

If, as has already been referred to, *Phora cleghorni* is truly para, sitic on the Silkworm Tachinid of India (*Trycolyga bombycis*), this would add another parasitic family to the Diptera, the Phoridæ. Moreover, it would mark a very striking deviation in the parasitism of the order. Four genera of Phoridæ are known in North America. The larvæ usually feed on dead snails, insects, and fungi, or are necrophagous.

Reviewing these families, we find that only two out of the seventeen can be classed as actually injurious. The Acroceridæ are parasitic on spiders, which latter are on the whole beneficial insects. The second family, the Oestridæ, are highly injurious.

The Conopidæ and Bombyliidæ, in so far as they destroy wild bees, including the humble bees, might be considered somewhat injurious, from the fact that the humble bees are of use in the fertilization of certain flowers, notably red clover. These two families contain about the only known dipterous parasites of bees. Four families are only partly parasitic in their habits. They are the Cecidomyiidæ, Sarcophagidæ, Muscidæ, and Anthomyiidæ. Such members of them as are parasitic destroy injurious insects.

The remaining families, the Conopidæ and Bombyliidæ being included-are practically without exception parasitic or injurious insects, if we may include the Dexiidæ, which accidentally and rarely diverge from these habits. These make eleven families, the genera in which sum up more than 225 in North America. Four or five species to each genus is a low estimate, making fully 1,000 North American species. It should be noted that these flies are practically without enemies, and therefore increase rapidly. This accounts for their great abundance, both in individuals and species, especially in the Tachinidæ. It can readily be imagined, therefore, that their agency in the destruction of injurious insects is of paramount importance.

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ENTOMOLOGICAL SOCIETY OF WASHINGTON.

October 5, 1893.—Mr. R. S. Lull, of the Maryland Agricultural College, was elected an active member. Messrs. W. D. Doan, of Coatesville, Pa.; J. L. Healey, of Rogers Park, Ill.; H. C. Fall, of Pomona, Cal.; H. F. Wickham, of Iowa City, Iowa; and L. W. Mengel, of Lancaster, Pa., were elected corresponding members.

Mr. Schwarz gave some additions to the list of North American termitophilous and myrmecophilous Coleoptera. Discussed by Messrs. Riley and Schwarz.

Mr. Marlatt read a paper on the neuration of the wings of Tenthredinidae, proposing a system of nomenclature of the veins, following closely that of Cameron and André, with a few minor changes. Discussed by Messrs. Ashmead, Riley, and Howard.

Mr. Hopkins presented some short notes upon certain wood-boring beetles, exhibiting drawings of the species. Tho forms mentioned were *Hylecoetus lugubris* from chestnut, *Serropalpus striatus* from black spruce, and *Eupsalis minuta* from oak, and an unknown Coleopterous larva injuring oak and chestnut. Discussed by Messrs. Schwarz and Riley.

C. L. MARLATT,
Recording Secretary.

November 2, 1893.—Mr. Heideman presented a design for a seal for the society, which was adopted.

Prof. Riley presented some "Remarks upon Belostoma" in which he gave a careful review of the synonymy of *Belostoma americanum* and *Benacus griseus*, indicating the structural differences between them based upon careful dissections. Discussed by Dr. Gill, Messrs. Schwarz, Ashmead, Heideman, and Howard. Prof. Riley read a second paper entitled "Remarks on the eggs of Ceresa" showing that his early figure of the egg punctures of a species which he called *C. bubalus* were in reality the punctures of *C. taurina* of Fitch, while the figure published by Marlatt and other western entomologists represents the true puncture of *C. bubalus*. Discussed by Mr. Ashmead, who pointed out the availability of the structure of the last ventral segment as a classificatory character in this genus. A discussion upon the use of the genitalia in classification followed, which was participated in by Drs. Gill Stiles, and Riley and Messrs. Ashmead and Schwarz. Dr. Riley read a third paper entitled "Notes from 'Sunbury'" in which he presented specimens of injury which conclusively showed that *Chrysobothris femorata* goes through all its transformations in less than a year and that *Trochilium syringæ* passes from the egg to the adult in Washington in at least three months.

Mr. Schwarz exhibited a Pterostichus the elytra of which were covered with a growth of some species of Laboulbeniaceae.

Mr. Ashmead showed a Floridian specimen of the Fulgorid African genus Amplicotes and said that he was familiar with a case in which a hymenopterous genus occurs both in Africa and in Florida, but not elsewhere.

Mr. Schwarz stated that the Halticid genus Argopistes has this same distribution.

Mr. Heidemann exhibited a new genus and two new species of Capsidae found near Washington.

Dr. Gill exhibited the cocoon of a species of Phydippus found in a bunch of grapes.

L. O. HOWARD,
Recording Secretary, pro tem.

SPECIAL NOTES.

Quarantine against injurious Insects.—At the Fruit-growers' Convention, held at Los Angeles, Cal., recently, an important paper, entitled "Suggestions on Quarantine," was read by Mr. Alexander Craw. The importance of effective quarantine was elaborated in connection with a brief review of the history of fruit-growing in California. It was shown that California is now importing fruits, trees, shrubs, plants, and seeds from Europe, Australia, China, Japan, South Sea Islands, South and Central America, and other localities, and that hardly a vessel arrives in the west coast ports which does not bring such objects, many of which are infested with some insect or fungus pest. The present quarantine regulations of California have been formulatedby the State Board of Horticulture, under the authority of the act organizing the Board. The first and, perhaps, the most necessary of these regulations reads as follows: "All consignees, agents, or other persons shall, within twenty-four hours, notify the Local Inspector or Quarantine Guardian of the arrival of any trees, plants, buds, seeds, pits, or scions at the first point of debarkation in the State of California." This regulation, as Mr. Craw points out, is a very good one, but fails of its effect for the reason that no penalty is attached to its violation. It is, therefore, ineffective, and throws the entire burden of discovery upon the vigilance of the local inspectors. At the Cape of Good Hope, however, a quarantine law is in operation giving the Governor power to provide by proclamation for protection against the importation and spread of pests, and providing a penalty for its contravention in a fine not exceeding five hundred pounds sterling, with the alternative of imprisonment at hard labor not to exceed two years. This law, if enforced, will certainly prove efficient, and Mr. Craw recommends the adoption of similar legislation in California.

He also advises the erection of fumigating houses at such railroad stations as receive shipments of fruit trees and fruit packages. These stations should be provided with facilities for retaining the infested stock until the local inspector can assure himself that it is free from dangerous pests. The opinion of Judge McKinley upon the validity

of the California quarantine laws is quoted nearly in full. It will be remembered that this decision was rendered in the case brought by the State Board of Horticulture against the owners of certain orange trees which were imported from Tahiti and which were infested by a scale insect new to California. We have already referred to this case and to Judge McKinley's decision upon page 400, Vol. IV, INSECT LIFE. So far as we know, California took the lead in regard to this matter of quarantine, and if this State succeeds in making its measures in this direction effective, it will deserve the gratitude of the fruit-growers of the entire country. The importance of such regulations in certain other States can hardly be overestimated, and Florida in particular needs some such quarantine law.

There are a number of enterprising horticulturists in Florida at the present time who are engaged in attempting to acclimate many subtropical plants of economic importance. We know already of several West Indian insects which have been brought into this country in this way and there are undoubtedly many more which should be guarded against. Florida will not be the only sufferer through negligence in this respect since, although her climate differs from that of the more northern States and the West Indian and South and Central American species imported will in many cases not spread to the northward, there are still a number of species, particularly among the scale-insects, which, though tropical or subtropical in origin, are potential pests of temperate regions as well. The whole country, therefore, is more or less interested in this question, and there can be no better illustrations of this fact than the recent occurrence of the pernicious San José Scale around Charlottesville, Va., and the likewise comparatively recent distribution of a West Indian Aspidiotus on Peach (*Aspidiotus lanatus*) which we have deemed of sufficient importance to treat of in our annual report for the year 1893.

Some Kansas Insect Notes.—In the Transactions of the Kansas Academy of Science (Vol. XIII, 1891–'92, pp. 112–115), Mr. Vernon L. Kellogg publishes some notes on injurious insects which will be of interest to economic entomologists. The species considered are the Wheat-straw Worm (*Isosoma tritici*), a new Bibio (*Bibio tristis* n. sp.), the Western Corn Root-worm (*Diabrotica longicornis*), the Ham Fly (*Piophila casei*), and the Fermenting Fruit-fly (*Drosophila* spp.). Mr. Kellogg shows that the Wheat-straw Worm occurred in about one-fourth of the counties of the State of Kansas in 1891 and was especially prevalent in central and western Kansas. The author, perhaps unwittingly, gives a wrong impression concerning the life history of this species in leading to the inference that it is single-brooded. No reference is made to its important dimorphism. Parasitism by *Eupelmus allynii* was noticed in all of the examinations made. The new Bibio

was abundant in many wheat fields, but no damage was positively traced to it. A great deal of damage in a packing house in Kansas City by the Ham Fly was reported in 1891; $1,500 worth of spoiled meats were returned in one week. Mr. Kellogg's breeding cage notes give the duration of the egg-state in this species as four days, the larval state about two weeks, and the pupal state one week, while the adult flies live from six days to two weeks. These observations hardly agree with those of Miss Murtfeldt, reported upon pp. 173, 174 of the last number of INSECT LIFE. Instead of four days she found the egg to hatch within thirty-six hours, while the larva, according to observations, completed its growth in from seven to eight days instead of in two weeks as reported by Mr. Kellogg. The average duration of the life of the adult she found did not exceed a week. All of which simply shows the variability in these respects of the same species, even where the conditions are substantially similar.

Papers on Iowa Insects.—We have just received from Prof. H. Osborn a brochure entitled "Papers on Iowa Insects, consisting of Fruit and Forest Tree Insects (reprinted from the Trans. State Horticultural Society, 1892) and Some Iowa Farm Insects (reprinted from the Report of the State Agricultural Society, 1892)." The little pamphlet consists of a series of condensed and well-illustrated articles upon the different insects which Prof. Osborn has found injurious in the State of Iowa in his many years experience as professor of zoology and entomology in the State Agricultural College, as entomologist to the State Experiment Station, and as a field agent of this Division. The matter is presented in attractive form and is to some extent a compendium of the subject which will be found extremely useful to Iowa farmers and fruit-growers. It covers 64 pages, closely printed brevier matter. The illustrations are nearly all borrowed, but are carefully accredited.

Recent Entomological Publications of the New Jersey Experiment Station.—Since we last noticed the publications of this Station, Prof. J. B. Smith has sent us Bulletins 94 and 95 and his Annual Report. Bulletin 94 is a consideration of the insects injurious to Cucurbs. The insects treated are the Boreal Ladybird (*Epilachna borealis*), the Striped Cucumber-beetle (*Diabrotica vittata*), the Squash Bug (*Anasa tristis*), the Melon Louse (*Aphis cucumeris*), and the Squash Borer (*Melittia ceto*). Like most of Prof. Smith's bulletins, this contains a number of original observations, and he seems to have followed out the life history of each insect for himself. The Squash Bug, ordinarily so difficult to fight, he proposes to treat by raking up and destroying a great major-

ity of the vines as soon as the crop is off, the object being to destroy all eggs and young on the vines and force the adults to other localities for food or shelter. The few plants left for seed can then be easily looked over and the insects handpicked. Handpicking in the early spring is also recommended. He has not ascertained the method of hibernation of the Melon Louse, but advocates the early search for the first individuals in June, when they should be handpicked and destroyed. Later he urges underspraying with kerosene emulsion. The bulletin contains a number of new figures, mainly prepared from photographs, which, while indicating general appearance and character of damage, are otherwise worthless. Bulletin 95 is a short compiled account of the Periodical Cicada. The Annual Report gives an account of the work done during the year and repeats much of the information given in the bulletins. If we have noticed Prof. Smith's station bulletins more often than those of other station entomologists, it is because he is one of the most prolific writers, and because, on the whole, he is doing some of the best and most original work.

The Four-lined Leaf-bug.*—In this bulletin Mr. M. V. Slingerland gives an elaborate account of *Pœcilocapsus lineatus*, showing that this leaf-bug has been very injurious recently to the foliage of currant and raspberry bushes in the State of New York. The author gives an elaborate account of the past history, destructiveness, and distribution of the pest, a lengthy list of its food-plants, an account of the insect's appearance and indications of its presence, classification, life history, and remedies, followed by bibliography and synonomy, the whole account covering something over 30 pages and illustrated by 13 text figures. The most interesting portion of the bulletin is the announcement that the species passes nine months of the year in the egg state and that the eggs are deposited in slits cut lengthwise into the stems of plants, extending through the bark-wood and nearly half way through the pith. In each of these slits from two to fourteen eggs are deposited. The insect is single-brooded in New York State. The remedies recommended are kerosene emulsion for the nymphs, destruction of the eggs by pruning, and the capture of the nymphs and adults by jarring into receptacles, where they are destroyed. The bulletin is among the most commendable of those which come to us and well illustrates the author's care and thoroughness, as well as his ability as an observer, though it may be questioned whether so much technical detail were not better relegated to publications addressed to specialists than included in those addressed ostensibly to farmers.

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*Bulletin 58, Cornell University Agricultural Experiment Station, Entomological Division, Ithaca, N. Y., October, 1893.

Insects Injurious to Celery.—Mr. G. C. Davis, consulting zoologist to the Michigan Agricultural Experiment Station, has just published as Bulletin 102 of that Station, an interesting report on insects injurious to celery in Michigan. A number of species not heretofore recorded as celery enemies receive treatment, among them several species of true locusts, several leaf-hoppers, the Tarnished Plant-bug (*Lygus pratensis*), the Flea-like Negro-bug (*Corimelæna pulicaria*), the Three-lined Thrip (*Coleothrips trifasciata*), the Celery Plant-louse (*Rhopalosiphum dianthi*), several Flea-beetles, the larva of *Papilio asterias*, the Spotted Cut-worm (*Agrotis C-nigrum*), the Celery Borer (*Phlyctænia ferrugalis*), and four Tortricids, viz, *Dichelia sulfureana*, *Sericoris bipartitana*, *Cacœcia rosaceana*, and *Tortrix pallorana*. Life histories of the insects where known are given, and the principal remedies consist in the use of "hopperdozers" and "hopperettes," two convenient styles of which are illustrated, the use of carbolic acid in the proportion of a tablespoonful to two gallons of water as a deterrent, kerosene emulsion, pyrethrum powder, poison trap system for the cut worm, cold water for the common Celery Plusia, and the cleaning up of leaves and refuse material for the leaf-rollers. The use of Paris green against the leaf-feeders is not recommended since the poison after spraying settles around the edible portion at the base. After two sprayings with Paris green at the rate of 1 pound to 175 gallons of water certain plants were washed without separating the stalks and prepared as for market. They were then analyzed by Dr. R. C. Kedzie, who found that each pound of celery contained 0.0368 grains of arsenic. Celery sprayed once only contained 0.0244 grains of arsenic to the pound. This is far below a poisonous dose, but on account of the cumulative effects of arsenic Mr. Davis recommends that it be not used. The bulletin contains a number of original illustrations, most of which are poorly done. The text, however, will be of much use to celery growers.

The Spraying of Orchards.—Bulletin No. 60 of the Cornell University Agricultural Experiment Station summarizes the experience of the Horticultural Division at the Station in regard to the spraying of orchards. The bulletin is prepared by Mr. E. G. Lodeman, who treats his subject under the three heads: (1) The Profits of spraying Apple Orchards; (2) Tests of some Fungicides and Insecticides Upon Peach Foliage; (3) Some novel Insecticides and Fungicides. The profits of spraying are once more conclusively shown. The testimony of a number of practical orchardists is given in addition to the very pronounced beneficial results of the Station work. Peach foliage is once more shown to be extremely susceptible to the action of the arsenites. The novel substances tried were Iron chloride, Zinc chloride, Lead acetate, Fostite, Boron compounds, Iodine, Nitrate of soda, Caustic potash,

Abretic acid, Kreolin, and Antinonnin. None of them proved efficacious either as fungicides or insecticides, with the exception of Antinonnin. Concerning this substance Mr. Lodeman finds that it must be kept moist, else it becomes dangerous to handle. When used alone the action upon foliage is extremely caustic and the substance must be applied highly diluted. Lime reduces its caustic action, but it possesses no practical value in destroying insects by contact. On the whole, the Bordeaux mixture remains the best fungicide and Paris green and London purple the best general insecticides.

The Entomological Society of Ontario.—We have just received the Twenty-fourth Annual Report of the Entomological Society of Ontario, covering the year 1893. It is, as usual, full of interesting matter and contains a number of important articles. As a frontispiece is given an excellent portrait of Rev. C. J. S. Bethune, for so many years connected with the Society and with the development of economic entomology in Canada. The annual address of the President, Mr. W. Hague Harrington, treats of several insects of economic importance, including the Larch Saw-fly, Rose Saw-flies, Canker Worm, and a number of less important species, concluding with a review of the entomological publications of the year. Other contributors to the Report are Mr. James Fletcher, who presents an account of the injurious insects of the year; Rev. T. W. Fyles, who writes a most interesting article upon the entomological mistakes of authors, from Spenser to Fenimore Cooper. Mr. Fyles also contributes an article on the season of 1893, giving a record of his captures. Mr. J. Alston Moffat gives a most interesting article on the subject of mosquitos; Mr. Harrington a note on Canadian Uroceridae, and some additional notes on Japanese insects; Rev. W. J. Holland some notes and queries; Mr. T. J. MacLaughlin a popular article on the Dragon Fly; Mr. William T. Davis, the song of Thyreonotus, and Mr. Fletcher again, notes on some of the more important entomological exhibits at the Chicago Exposition. The volume concludes with an extended account of the Fifth Annual Meeting of the Association of Economic Entomologists, printing a number of the papers in full.

THE INSECTS OCCURRING IN THE FOREIGN EXHIBITS OF THE WORLD'S COLUMBIAN EXPOSITION.

By C. V. Riley.

Beginning with the first week of October and continuing at intervals up to date of writing, a number of newspaper articles and notices have appeared bearing upon the subject of the insect-infested grain exhibits at the World's Fair. From these accounts, nearly all of which are more or less erroneous, imperfect, and misleading, all sorts of opinions have become prevalent as to the ultimate danger of the introduction of new and undesirable insect pests. Indeed, some newspapers have seemed to take delight in magnifying the danger and in reflecting upon Chicago and the Exposition, and have even used a report, made by me to Mr. W. I. Buchanan, chief executive of the Department of Agriculture of the Exposition, and presently reproduced, as a basis for these exaggerated and somewhat sensational articles. Under the circumstances a full and truthful statement of the facts will serve a useful purpose.

In the first newspaper accounts which appeared the damage was with great uniformity attributed to "the weevil," which with equal uniformity was stated to be a new species introduced into the Agricultural Building in some of the foreign exhibits. For the benefit of the general reader it should be stated that while there are but two true grain weevils known to be established in this country, viz, the Rice Weevil (*Calandra oryzæ*) and the Grain Weevil (*C. granaria*), a score or two of other insects which attack grain after the manner of Calandra, are of common occurrence with us, and several of them are popularly but erroneously known as grain weevils.

On July 15 last I wrote to Mr. F. H. Chittenden, one of the assistants of this Division, then in charge of the entomological exhibit of the Department in the Government Building of the Exposition, to keep a lookout for new insects in the cereal exhibits of foreign countries and to report thereon. Acting under these instructions, Mr. Chittenden employed such opportunities as offered, and paid several visits through the summer to the foreign exhibits on the grounds of the exposition. Of the earlier species found, represented chiefly by dead specimens taken from jars of herbs, roots, seeds, and the like, a few were indeed new, but the living insects all proved to be of common and well-known species. Later, however, toward the close of September, many species not hitherto observed began to make their appearance in such

numbers in the Agricultural Building as to cause very general alarm among the exhibitors of agricultural products. Correspondence was had with the Division, and specimens sent by one of the State commissioners all proved to be well-known species already existing in this country.

Early in October a meeting of the State executive committee was called at which the subject of the distribution of insect-infested grain was seriously considered. The immediate cause of this discussion was due to the discovery of a large number of the common Rice Weevil (*Calandra oryzæ*) in the show cases of some of the State exhibits in the immediate neighborhood of the section devoted to the South American countries. The extreme abundance of the weevils in the exhibition cases referred to, which were so tight as to be nearly weevil-proof and covered with glass, makes it highly improbable that they were introduced in any foreign exhibits, but indicates that they were brought in an immature state in the grain from the States in whose exhibits they were found. The fact that the exhibitors or persons in charge of these exhibits protested with one accord that "the weevil" was unknown in their respective States counts for naught, since it is a well-established fact that this particular species is of common occurrence in every State and Territory in the Union.

At the meeting of the State commissioners referred to, a special committee was appointed to further investigate the matter and take such steps as should be found necessary. An expert report was also demanded, but, so far as could be learned, nothing whatever was done, nor was any attention paid to the circular letter which was sent out a day or two after this meeting by Mr. Buchanan. Of this letter, which was addressed to the commissioners of the various States and foreign countries having exhibits in the Agricultural Building, the following is a transcript:

To the Commissioner for ——,

Agricultural Building:

DEAR SIR: In order that there may be no possible danger of the introduction into this and other countries of the insect that has been found in the grains of several countries and States in the Agricultural Building, you are urgently requested to promptly carry out the following:

(1) Take immediate steps to have destroyed in the garbage crematory all grain in which the insect is found. Janitors will be instructed to take the grain you designate to the crematory if you so desire.

(2) Stop at once giving away or receiving samples of wheat, corn, oats, and other grains in which the insect works. Printed notices will be placed in the building cautioning visitors against taking away any samples of such grains.

(3) Seal all jars that contain wheat or other grain that attracts the insects.

(4) Make daily examinations of your exhibit and in every instance where the insect is found follow instructions in paragraph No. 1.

It is highly important that this be given your immediate attention,

Very respectfully, yours,

W. I. BUCHANAN,
Chief Department of Agriculture.

A keen interest was awakened in the subject, as made manifest by the articles in the columns of the daily papers of Chicago and by the correspondence with this Department. It finally assumed such dimensions that, at the telegraphic request of Mr. Buchanan, I was authorized by the Secretary of Agriculture to proceed to Chicago in order to make a personal survey of the matter and such recommendations as might be deemed advisable. A week of active work at the fair grounds, with the assistance of Mr. Chittenden, who had been, as already indicated, engaged for some time previously in investigating the matter, enabled me to draw up a preliminary report, which was addressed to Mr. Buchanan, embracing the essential features in the case, a list of the principal species found, and recommendations for the treatment of the infested material. This report, omitting the list of species, which is amplified in another place in this article, is reproduced herewith:

In view of its importance and of the interest which has been recently manifested in the subject of the insects that are injuring the various exhibits of agricultural products, and especially of grains, at the exposition, I have concluded to give you a brief statement of the actual facts.

No one recognizes more fully than I do the possibilities of harm from the introduction and distribution of undesirable insect pests, from which the United States has hitherto been free, or of the converse possibility of the injury we might do to other countries by sending them from this country undesirable species which they do not possess. The fact that Secretary Morton and Assistant Secretary Willits, of the U. S. Department of Agriculture, are equally alive to the importance of the matter is manifest by my presence here.

The following review of the condition of things is based on a personal survey of the field by myself and by careful examinations made during the last few weeks by Mr. F. H. Chittenden, one of my assistants, who has been specially charged with this work.

Some forty-odd species have been discovered and more or less carefully examined and studied. These may be divided into two categories, viz:

(1) Those which are already common in the United States and are for the most part cosmopolitan species; and

(2) Those which are either unknown or limited in their distribution in the United States.

By far the larger number of the insects affecting the exhibits of food products belong to the first category, and, in fact, almost everyone of the two dozen species contained in the exhibit of the Division of Entomology of the Department of Agriculture, as affecting stored grain, and enumerated on pp. 46 and 47 of the catalogue of said exhibit (Bulletin No. 31 of this Division), are to be found on the Exposition grounds. A number of the species found have no popular name, and their enumeration will convey little information to the general reader; yet I will give the list as a text for my conclusions and recommendations. [Omitted because amplified further on.]

The insects in the above list which have caused the greatest amount of damage are the two which are most commonly found in stored grain and other cereal products, viz, Nos. 1 and 14. These are the two that were sent on to me at Washington by one of the State commissioners, and have been referred to in the newspapers as "the Weevil."

No. 1, or the Rice Weevil, is believed to be a native of India, where it has been known to be an enemy to stored grain for over a century, and, perhaps, from time immemorial. The annual loss occasioned by it alone to wheat exported from India

was estimated five years ago to have amounted to £150,000 sterling. The species is perhaps the most widely distributed of known insects, being found in all quarters of the globe where grain is used, but is more injurious in tropical climes than in our own country, where, though it ranges from Alaska to Florida, it does its greatest damage in the Southern States. A correspondent estimates that there is an annual loss of $1,000,000 from this insect in Texas alone.

This insect appears in nearly all the cereal exhibits of tropical countries, as of Guatemala, Costa Rica, Mexico, Trinidad, Curacao, British Guiana, Brazil, Paraguay, Uruguay, Ecuador, and Argentine Republic, of this continent; and in Cape of Good Hope, Liberia, Orange Free State, Tunis, Siam, New Caledonia, Ceylon, and Java of the Eastern Hemisphere, and Australia.

It is particularly abundant in and about the vicinity of the Wisconsin and Minnesota sections in the Agricultural Building of the Exposition, and there is no doubt but that it was brought to the World's Fair from most of the countries mentioned, having existed in the egg or larva state before the grain was shipped.

The Rice Weevil infests grain of all kinds, seeming to thrive best in wheat, but attacking also maize, rice, Kaffir corn, and beans.

The mature Rice Weevil is a small, elongated beetle, about one-eighth of an inch long, dark brown in color, with four reddish spots at the corner of the wing cases. The female lays her eggs in the kernels of the grain, and the young are small, whitish grubs or larvæ, which, after transforming to the pupa state, issue as perfect beetles again. The species breeds rapidly and one generation follows another in from three to eight weeks, according to temperature. The egg-laying period of a single female continues through several weeks, and as there are from six to eight broods annually, the remarkable rapidity with which grain is ruined is not to be wondered at. This species is particularly bad in the Southern States and is gradually replacing the other species of its genus similarly known to infest grains.

No. 2, or the Angoumois Grain Moth, likewise abounds in southern grain fields and granaries, but is less injurious as we go northward. It is supposed to be of South European origin, but has been known in this country since 1728. It derives its popular name from the great destruction which it caused in the province of Angoumois, France, a little more than a century ago. It is a moth of a very light, grayish color, with four wings, more or less spotted with black. It measures about half an inch across with wings expanded and about a quarter of an inch in length with the wings closed. The eggs are delicate, pale red in color, with prismatic reflections, and they are laid in sheltered positions, as in the longitudinal grooves and the membranes which the different grains afford. The young are small, white, active worms, with a dark head, moving about actively by means of legs and spinning a silken thread.

This species, which is also cosmopolitan, is found in almost all the exhibits and is, in fact, flying all over the grounds.

Of all the insects belonging to the second category, [List also ommitted] a large number were found dead, and either died in the herbs, drugs, or other products in which they were found, since the Exposition opened or before they were shipped from the countries from which the exhibits were sent.

A certain number of the species, all those except the four last named, belong to those species which have already obtained a limited foothold in North America, or from which there is little to fear; while the small balance (Nos. 31, 32, 33, and 34) are of species either heretofore unrecorded in North America or not sufficiently studied to intelligently report upon, as some of the species can not be accurately determined without comparisons, which it is impossible to make in Chicago from lack of accessible collections. It is to this last limited list that I would draw your special attention.

RECOMMENDATIONS.

The insects in the first category, two of which, as I have shown, have been the cause of whatever excitement there has been on the subject, may be dismissed without further attention, as far as North America is concerned. These and other more or less cosmopolitan species will multiply wherever they have an opportunity, but can cause us no harm by dissemination, as they are already with us. It may be different with some of our foreign exhibitors, and it behooves the representatives of foreign countries to be careful and not take back with them our own grains, or other products that are infested, unless they are sure that the species already occur with them. Whenever exhibits are infested as they almost invariably are in artistic designs made of grains which are more or less exposed, it behooves the exhibitors who wish to preserve such designs for future exhibit, to disinfect them.

In reference to the insects of the second category, Nos. 23, 24, 25, 26, 27, 28, and 29 may also be dismissed without further consideration, especially from an agricultural point of view. No. 30 is also not of vital importance, but I would strongly urge that all the exhibits containing them be absolutely destroyed, or if distribution is contemplated, first thoroughly disinfected. The few remaining species, 31, 32, 33, and 34, are interesting and important, and I strongly urge that effective measures be taken to either destroy the exhibits containing them or to thoroughly disinfect the same.

MEANS OF DESTROYING UNDESIRABLE SPECIES.

I have already, in official correspondence from Washington, in reply to specific questions, given recommendations for destroying the insects now working in the exhibits or of disinfecting said exhibits: First by the destruction of all living insects by submitting the exhibits to a temperature of over 200° F. either by dry heat or steam heat; secondly, by the use of the fumes of bisulphide of carbon.

In either case, some large, air-tight receptacle must be provided into which the exhibit may be placed. A large galvanized iron tank, with properly grooved lid or other openings, and with shelving to accommodate the various small exhibits, would be useful for this purpose, and I would strongly recommend that such a disinfecting receptacle be built, which should be sufficiently strong to stand the amount of heat which I have suggested, and sufficiently tight to permit the use of the bisulphide of carbon where the heat can not be applied. The precautions necessary in using and the methods of using bisulphide of carbon are generally well understood, and it is only needful to state that it must be carefully used, as the fumes are very explosive. Being heavier than air, these fumes will sink to the bottom of any receptacle; hence it is best to place the vessel containing it in the upper portion of such receptacle. About 1½ pounds are sufficient for a ton of grain.

In the above report, I have said nothing of the insects affecting the woolens, furs, and skins, etc., on exhibit, as to enter into this subject would make this report much longer than I intend, and also because there is not, relatively, as much danger of foreign introductions, since from observation, and inferentially, they are likely to be species already with us and cosmopolitan. Should occasion require, I will report on these later.

Concluding, it may be safely stated that a careful and intelligent review of the state of things removes unnecessary apprehension and is, on the whole, gratifying, as the species which might prove undesirable and injurious introductions are extremely few and easily managed, if the precautions which I have suggested be carefully taken.

I do not believe that dependence should be placed on any general orders such as that issued on the 3d instant, as experience shows that such general orders are rarely carried out. There must be somebody appointed whose duty it will be to see that the special work be done in the cases indicated, and that it be done thoroughly. If

left to the individual exhibitors to do at their own discretion, as in a general order, the danger is that the work will not be done at all. For this reason I strongly urge that some competent person be appointed to carry out whatever orders you may issue.

Some thirty-five species were enumerated in all, in the different series, but since the report was made the remainder of the material collected then and afterwards has been more fully identified by comparison with specimens in the National Collection and published descriptions, and the list is now as complete as it is possible to make it with the means for identification at our command. A number of the species, it has been found, can not be identified with the material at our disposition, and types of these, some of which are probably undescribed, have been sent to Dr. David Sharp, of Cambridge, England, for further study. A list of the species, together with notes on their occurrence, food-habits, and distribution, is appended, the cosmopolitan beetles being arranged to conform to the nomenclature adopted by M. Fauvel in his recently published list of the Coleoptera common to Europe and North America.

LIST OF INSECTS WHICH OCCURRED IN GRAIN AND OTHER STORED VEGETABLE PRODUCTS AT THE WORLD'S FAIR.

COLEOPTERA.

Clavicornia.

(1) *Homalota* sp.—A minute Staphylinid beetle, living in yam and other edible tubers from Mexico. This species is not injurious.

(2) *Silvanus surinamensis* L.—Occurred in some abundance in the exhibits of Argentine Republic, Brazil, Paraguay, Mexico, Trinidad, Liberia, Algeria, Tunis, Java, Greece, and Italy. Injurious to grain and dried fruits. Cosmopolitan and widely distributed in North America.

(3) *Silvanus bidentatus* Fab.—In chick-peas from Spain. Common to both continents, in grain and under bark.

(4) *Silvanus quadricollis* Lec. (=*gemellatus* Duv. [Fauvel]).—In the Brazilian exhibit, in sugar (accidental). Not uncommon in grain, cotton bolls, etc., in the South.

(5) *Silvanus cassiæ* Reiche (?).—Breeding in edible tubers in Mexican exhibit. Recorded from Arizona (Fauvel).

(6) *Silvanus advena* Waltl.—In exhibits of Brazil, British Guiana, Porto Rico, Venezuela, Mexico, Algeria, Liberia, etc., in grain, beans, edible tubers, dried fruits, etc. Cosmopolitan, common, and widely known in this country.

(7) *Nausibius clavicornis* Kug. (*dentatus* Marsh).—Found in preserved bananas in the Jamaican exhibit in the Manufactures Building. Cosmopolitan.

(8) *Pediacus depressus* Hbst.—In chick-peas from Spain. Common to Europe and North America.

(9) *Læmophlœus pusillus* Sch.—In grain and meal from Brazil, Uruguay, Paraguay, and Liberia. Cosmopolitan; occurring in the United States, but not known if it is injurious.

(10) *Læmophlœus ferrugineus* Steph.—Found in betel nuts from Johore. Said to be cosmopolitan, but its naturalization in this country doubtful. Apt to be confounded with the preceding species.

(11) *Cryptophagus acutangulus* Gyll. (?).—In Mexican exhibit. Common to Europe and North America. Not known to be injurious.

(12) *Cryptophagid* (?).—An unknown species, dark, shining brown in color and about five-sixteenths of an inch in length, living in corn meal, edible tubers, etc., in Mexican and Guatemalan exhibits. Would certainly prove dangerous if it could become naturalized here.

(13) *Litargus* sp.—A Mycetophagid beetle, not easily separable from *balteatus* Lec., breeding in numbers in various edible tubers, including potatoes, in exhibits of Mexico and Guatemala. None of this genus appears to be recorded as injurious.

(14) *Typhœa fumata* L.—Noticed only in Siamese exhibit. Common in this country and said to feed on stored grain, but not known to be injurious.

(15) *Carpophilus hemipterus* L.—A Nitidulid breeding in abundance in dried fruits in Tunis Building; also in Algerian and Guatemalan exhibits. Cosmopolitan.

(16) *Carpophilus dimidiatus* Fab.—Breeding in corn meal from Brazil. Widely known in the United States, but not known to be particularly injurious.

(17) *Ips 4-guttatus* Ol. (*fasciatus* Ol.).—Living in dates in Tunis Building. Abundant in the United States, but not known to injure dried fruits.

(18) *Lathridius minutus* L.—In Mexican and Spanish exhibits. Common in the United States.

(19) *Coninomus* sp.—Also from Mexico.

(20) *Corticaria ferruginea* Gyll.—From Spain and Mexico.

(21) *Corticaria serrata* Payk.—Also from Spain. Common to Europe and North America.

(22) *Corticaria* sp.—From Algeria.

Of the five minute Lathridiidæ above mentioned none are known as noxious.

(23) *Tenebrioides mauritanicus* L.—Occurred in corn, wheat, flour, and meal exhibited by several South and Central American countries. All the known species of this genus are predaceous, and its noxiousness largely consists in its presence, which, as it is a large species, is unwelcome in edible products.

(24) *Ostoma* (*Lophocateres*) *pusillum* Klug.—In cereal exhibits of Siam, Liberia, and Ceylon. Not included in our faunal lists, but believed by M. Fauvel to occur in North America. Uncertain whether predaceous or injurious.

Ptinidæ.

(25) *Dinoderus* sp.—Living in grain and edible tubers from Mexico and Guatemala. Liable to prove dangerous if it can become acclimated.

(26) *Dinoderus pusillus* Fab.—From Mexico; in exhibits of Mexico and Italy. Known to injure stored grain and other products in North America, and said to be cosmopolitan, but somewhat limited in distribution.

(27) Drug-store Beetle (*Sitodrepa panicea* L.).—In a variety of exhibits, including grain, and from various countries. Cosmopolitan and a well-known pest in drug-stores everywhere.

(28) Cigarette Beetle (*Lasioderma serricorne* Fab.).—No special search was made for this species, as it is widely known, occurring wherever tobacco is grown or stored. It was found, however, in all tobacco exhibits examined. It has received frequent mention in the past in this periodical.

(29) *Catorama tabaci* Guer. (?)—In commercial annatto from Brazil.

(30) *Hemiptychus gravis* Lec. (?)—Occurred with the above, which it closely resembles.

(31) *Lyctus* sp.—One of the "powder-post" beetles; in herbs in Paraguay exhibit.

Cerambycidæ.

(32) *Leptostylus* (?) sp.—A Cerambycid or long-horned beetle; in pods of Enterolobium from Paraguay.

Bruchidæ.

(33) Pea Weevil (*Bruchus pisorum* L. [*pisi* L.]).—Noticed only in exhibits of Turkey, Brazil, and Utah. Said to occur wherever the pea is cultivated.

(34) European Bean Weevil (*Bruchus rufimanus* Boh.)—the *Bruchus granarius* L. of many writers—occurred in most exhibits of large "broad" or Windsor beans, including those of Spain, Italy, Algeria, and Tunis. Although this species has frequently been brought here it has probably not obtained permanent footing in the United States.

(35) Common Bean Weevil (*Bruchus obtectus* Say).—The most formidable enemy of cultivated beans in North America. Beans damaged by this species were seen in the exhibits of Brazil, Venezuela, Mexico, Spain, Indo-China, etc.

(36) Lentil Weevil (*Bruchus lentis* Boh).—In lentils from Spain and Turkey. Has been reported from New York, but not known to have become introduced here.

(37) *Bruchus 4-maculatus* Fab.—Swarmed in beans from Brazil and Venezuela. Common in our more Southern States.

(38) *Bruchus chinensis* L. (*scutellaris* Fab.).—Breeding in profusion in bean exhibits of Japan and Porto Rico. Known in this country, but not yet widely distributed.

(39) *Bruchus chinensis* variety.—A small form of the preceding; in cultivated legumes from Ceylon.

(40) *Bruchus* sp.—A small species somewhat like the preceding; in cultivated beans from Brazil. Probably new and injurious, but no living specimens noticed.

(41) *Bruchus* sp.—A broad, reddish-brown species resembling in markings *B. obtectus*, in "pigeon peas" from Trinidad. This species is also liable to be injurious, but was not found living.

(42) *Bruchus* sp.—In wild legume from Costa Rica.

(43) *Bruchus* sp. —From seeds of Annatto from Paraguay and Venezuela

(44) *Bruchus* sp.—In seed pods of Divi-divi from Curaçao.

(45) *Bruchus* sp.—In wild legume from Argentine Republic.

(46) *Bruchus* sp.—Bred from Enterolobium pods from Paraguay.

(47) *Bruchus* sp.—Bred from wild legume from Brazil.

(48) *Caryoborus* sp.—In vegetable ivory from Ecuador.

None of the seven species last mentioned are likely to be of economic importance in this country.

(49) *Spermophagus* (*Zabrotes*) sp.—A form resembling our native species; breeding in the greatest abundance in cultivated beans in the exhibits of Guatemala, Brazil, and Mexico. Likely to be introduced, and without doubt a dangerous species.

Tenebrionidæ.

(50) *Tenebrio* sp.—A living larva of this genus, probably either *T. molitor* L. or *T. obscurus* Fab., our common "meal worms," was found in corn in the Guatemala Building.

(51) *Tribolium ferrugineum* Fab.—Occurred in the cereal exhibits of most of the countries of tropical and subtropical America, Asia, and Africa, ranking in abundance with the Rice Weevil and Angoumois Grain Moth. Common also in Europe, and well distributed over this country, where it is sometimes called "flour-weevil," and is often injurious to grain, meal, flour, and a great variety of other products.

(52) *Tribolium confusum* Duval.—Occurred in Annatto from Liberia. The same form occurs in the United States, where it has been generally confused with the preceding, from which it differs chiefly in the form of the antennæ.

(53) *Palorus melinus* Hbst. (*depressus* Fab.)—In meal from Brazil. Although not recorded in Henshaw's List, a series of this species in the National Museum shows that it is probably entitled to a place in the list of introduced species.

(54) *Gnathocerus cornutus* Thunb.—Occurred in the Brazilian exhibit in flour. It is said to be cosmopolitan but is recorded only from the Pacific coast of North America.

(55) *Echocerus maxillosus* Fab.—Occurred in meal in the Brazilian exhibit, and is doubtless firmly established in this country, although still limited in distribution.

(56) *Alphitobius piceus* Ol.—In a jar of sorghum (?) seeds from Indo-China.

(57) *Alphitobius ovatus* Hbst. (*diaperinus* Muls.).—In an unknown product in the Siamese exhibit.

The last two species are cosmopolitan, and recorded in our local lists. Probably scavengers, at least not known to be injurious in America.

(58) *Phylethus* (*Alphitophagus*) *bifasciatus* Say.—Living in abundance in dried fruit in one of the Central American buildings. Common in the United States, but not known to injure dried fruits. Observed by Mr. E. A. Schwarz, of this Division.

Rhynchophora.

(59) Rice Weevil (*Calandra oryzæ* L.).—This species, as stated in the report to Mr. Buchanan, was found in the cereal exhibits of nearly all the tropical countries of both hemispheres. It thrives on all kinds of stored grain, including maize, wheat rice, rye, Kaffir corn, barley, oats, etc.

(60) European Grain Weevil (*Calandra granaria* L.).—Occurred in the cereal exhibits of Spain, Mexico, Algeria, Cape of Good Hope, etc., being found in the greatest abundance in chick-peas. Although common enough in the United States it is still limited in distribution.

(61) *Calandra remotepunctata* Gyll.—Considered merely a variety of the above.

(62) *Calandra* sp.—A weevil similar to the two preceding, from leguminous seeds or beans from Brazil.

(63) *Balaninus* sp.—Larva in acorns from Algeria.

(64) *Cryphalus jalappæ* Letz.—A small Scolytid in German exhibit in Manufactures Building. Infests jalap of commerce, but not considered detrimental.

(65) *Coccotrypes dactyliperda* Fab.—Occurring in fruit of three species of palms exhibited by an Italian firm.

(66) *Coccotrypes* sp.—In leguminous pods from Paraguay.

(67) *Hypothenemus eruditus* Westw.—A single dead specimen of this cosmopolitan species which is discussed somewhat at length in Mr. F. H. Blandford's article in this number, was picked up in the Agricultural Building.

(68) *Aræocerus fasciculatus* DeG.—Breeding in mace from Trinidad and Johore, and in cocoa beans from Liberia. Common in Southern States, but not especially injurious.

The following, each represented by a dead specimen, were undoubtedly of accidental occurrence:

(69) *Platynus* sp.—In a jar of chick-peas from Spain.

(70) *Conosoma littoreum* L.—With the above.

(71) *Otiorhynchid.*—In a jar of Brazilian beans.

LEPIDOPTERA.

(72) Indian Meal Moth (*Plodia interpunctella* Hbn.).—This well-known species occurred in abundance in several buildings in the exhibits of Argentine Republic, Brazil, Guatemala, Mexico, Cape of Good Hope, Orange Free State, etc., in grain, dried fruits, nuts, seeds, etc.

(73) Mediterranean Flour Moth (*Ephestia kuehniella* Zell.).—Living in meal, bran, and cakes in Mexican exhibit. Already introduced, but not widely known as a pest.

(74) *Ephestia* sp.—Breeding in most exhibits, of which there were many, of cocoa beans. Infested beans are not considered by manufacturers in any way inferior to those which are free from attack. This moth has certainly been imported, many times a year, probably, for the past century, and as it is not positively known to have become naturalized here there is little to fear from it in future.

(75) *Ephestia* sp.—A similar moth to *E. kuehniella*, but somewhat larger and

darker. Bred from seed pods of St. John's bread in the exhibit of the Spanish colonies.

(76) *Ephestia* (?) sp.—A dull gray moth, with an expanse of about five-eighths inch, bred from a gall in the Japanese section of the forestry building.

(77) *Tinea* sp.—A moth with an expanse of about half an inch, white, with the fore wings spotted with black after the manner of *T. granella*, was found infesting seeds of date palm in the Italian exhibit.

(78) *Tinea* sp.—A moth resembling the preceding, infesting Bombay nutmeg or soap nut exhibited by an American firm in the Agricultural Building.

(79) Angoumois Grain Moth (*Gelechia cerealella* Ol.).—This species, as already stated in my report to Mr. Buchanan, was very generally distributed about the grain exhibits in various buildings, and was, in fact, flying about all over the grounds. A rather full account of this species will be found in my Annual Report for 1884 and another in the preceding volume of INSECT LIFE (vol. v, pp. 325–328).

Four moths in such condition as to render identification doubtful were found as follows:

(80) From Acacia pods in Costa Rica Building.

(81) From leguminous pods from Paraguay.

(82) In case containing products from New Caledonia.

(83) Injuring yeast cakes in exhibit of Johore.

Among other products damaged by moths the following may be mentioned:

Beans from Paraguay; currants from Greece; velvet-seeds from Jamaica;* locust beans from Algeria, and various nuts and seeds in other exhibits.

It might be added here, as an interesting entomological fact, that the Army Worm (*Leucania unipuncta*) was found in some cereal from Mexico, living specimens hatching out in one of the cases in their section.

OTHER ORDERS.

(84) Anthomyiid.

(85) Anthomyiid (?).

(86) Stratiomyid.

The above three species of Diptera occurred in tubers and herbs in the Mexican exhibit. The first was identified by the adult, the other two by the puparia.

(87) The American Cockroach (*Periplaneta americana*) was noticed in the Brazilian exhibit.

(88) *Lyctocoris* sp.—A Heteropteron, resembling the bedbug, breeding in tubers in the Mexican exhibit.

(89) *Pemphigus* sp.—Bred from a gall-nut in the Japanese exhibit of the Forestry Building.

(90) *Atropos* sp.—In nuts in Algerian exhibit.

(91) *Atropos* sp.—In various exhibits of different kinds, particularly those of Brazil and Mexico.

(92) *Gamasus* sp.—A minute mite in Mexican corn exhibit.

(93) *Gamasus* sp.—With the preceding.

None of the last seven mentioned are of any great economic importance, save the cockroach, which is already widely distributed.

Of hymenopterous parasites the following were found:

(94) *Pteromalus calandræ* How.—Parasite of Rice Weevil (*Calandra oryzæ*). In Mexican exhibit.

(95) *Catolaccus* sp.—On sack of corn in Mexican exhibit.

(96) *Diglochis* sp.—Parasite of *Lyctus* sp. from Paraguay.

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*The author of this injury is probably the Ephestia, mentioned in this number under the title "Some Jamaican insects," among the general notes.

(97) *Meraporus* (?) sp.—Fairly swarming in French section of Agricultural Building in grain in sheaf, badly infested with *Gelechia cerealella.*

(98) *Meraporus* sp.—Parasite of *Bruchus 4-maculatus* from Brazil.

(99) *Meraporus* sp.—One other species, which has been referred to this genus by Mr. Ashmead, was found at large in the agricultural building.

(100) *Atelcopterus tarsalis* Ashm.—Parasite of *Silvanus surinamensis.* Taken with its host in the exhibit of Argentine Republic.

(101) *Prosacantha* sp.—In Spanish exhibit.

All of the above are minute four-winged flies, the first six belonging to the family Chalcididæ, the last two to the Proctotrypidæ. They are all more or less beneficial according to their abundance, serving in a measure to check the excessive multiplication of their injurious hosts.

ECONOMIC IMPORTANCE OF SPECIES FOUND IN VEGETABLE PRODUCTS.

In the Coleoptera, the Clavicorn series, represented by Nos. 1 to 24, is composed largely of scavengers and predaceous species. Of the injurious forms not already introduced only No. 5 (*Silvanus cassiæ ?*), 12 (the Cryptophagid ?), and 13 (*Litargus* sp.) are of importance, while the exact economic status of 24 (*Ostoma pusillum*) is doubtful.

The species of the family Ptinidæ, which includes Nos. 25 to 31, are, with one or two exceptions, more or less injurious. No. 26 (*Dinoderus* sp.) is the only unintroduced species to be feared, although the further distribution of 25 (*Dinoderus pusillus*) would be undesirable.

Of the family Bruchidæ or bean weevils (Nos. 33 to 49), the first seven are known to be injurious to beans, peas, or lentils, and 40 and 41 are probably so. A portion of these that are not known to live in this country were found only as dead specimens, and hence may not be able to live continuously in dried legumes. Those most to be feared are 37 (*Bruchus 4-maculatus*) and 38 (*B. chinensis*), both already introduced, but as yet limited to the more Southern States. No. 48 (*Spermophagus* sp.) is not known to occur here, and its introduction is not desirable. These three occurred in abundance at the Fair, and in their habits in living in dried beans resemble the common Bean Weevil.

Of the Tenebrionidæ, the first six are meal-worms and injurious. Of these four species, viz, *Palorus depressus*, *Gnathocerus cornutus*, *Echocerus maxillosus*, and *Tribolium confusum*, have not yet been very extensively distributed through the United States, and their further dissemination is to be avoided.

The Rhynchophora or true weevils (Nos. 59 to 68) contain nothing new of importance.

In other orders only the three grain moths—the Indian-meal Moth, the Angoumois Grain-moth, and the Mediterranean Flour-moth—are worthy of much consideration. The first two are cosmopolitan and the third is nearly so.

To sum up, there is every probability that all of the species enumerated in the foregoing list as having been found in grain and other

edible products had previously been brought to this country. A considerable proportion of the injurious cosmopolitan species are still confined in the United States to the Atlantic and Pacific coast cities and to the neighborhood of large commercial centers.

ON THE DANGER OF NEW INTRODUCTIONS.

The interchange of seeds, it was learned by inquiry, was confined almost entirely to the countries whose exhibits were free from any dangerous species. This interchange and the promiscuous distribution of seeds practically ceased with the appearance of the circular sent out from Mr. Buchanan's office requesting the abandonment of the same. Thousands of samples were taken away from open bags and other receptacles, but the insects infesting such exposed samples were for the most part confined to the commonest species, and the chances of introduction from these handfuls are extremely small. The same is true of the sheaves of cereals used in the decorations, which were taken away in armfuls by visitors at the close of the Fair. Finally, the very thorough work of disinfection, as presently set forth, diminished the chances of undesired introductions to a minimum.

The four species already mentioned as those from which the greatest danger was to be apprehended, viz, the unknown species of Cryptophagidæ, Litargus, Dinoderus, and Spermophagus, are tropical species, and could hardly become acclimated at the North. One or more of them might have become established in the extreme Southern States if they had escaped, but I do not hesitate to say, considering all the facts, that the probabilities of such a contingency are slight, and that no species which affect stored grain or other vegetable products have been distributed or have found a foothold in regions where they could multiply and become injurious. On the whole, therefore, it may be confidently stated that a thorough review of the facts gives assurance that no dangerous introductions were made, for, even if some of the species indicated as not previously found within our borders should become established, they are of such a nature as not to compare with the more cosmopolitan and injurious species which already affect our grain and which we already have to contend with.

TREATMENT OF INFESTED CEREAL EXHIBITS.

I was quite anxious that nothing should be left undone to effectually disinfect or destroy those exhibits which contained species that were new to North America and which were undesirable introductions, and, although unable to remain until the close of the Exposition or carry on this work personally, I was glad to be able to make an arrangement with Mr. Buchanan whereby Mr. Chittenden was especially engaged

to superintend this work of disinfection and destruction in accordance with the recommendations which I had made. The report which Mr. Chittenden has submitted justifies the conclusions just set forth and is as follows:

A large iron tank, with a capacity of about 1½ tons, was procured and provided with a shelf and a large tightly fitting door. A small building, known as the "Stock Exchange," situated near the Agricultural Building, was next secured and fitted up as a workroom. In this the tank and other materials used in the disinfection of the grain were stored. A large quantity of material was removed to this building and disinfected as rapidly as time would permit.

It was seriously contemplated by those in authority to destroy all the grain in the Agricultural Building, whether foreign or domestic, infested or free from insects; in fact, Chief Buchănan was quoted in one of the Chicago daily papers as having expressed this intention. To prevent such a contingency and to decisively settle the matter to the satisfaction of all, it was considered best to remove all the infested material from the foreign exhibits of this and other buildings. As soon as all necessary arrangements were perfected and the requisite permissions from commissioners, custom-house officers, and others were obtained for the removal of infested exhibits, the work was begun and rapidly pushed to its completion.

It was impossible to use bisulphide of carbon, benzine, naphtha, or other insecticides of this nature in the buildings, the insurance policies held by the Exposition prohibiting the use of inflammable substances, and it was therefore necessary to remove material to be disinfected from the buildings.

Experience having shown that Indian corn and, after that, wheat are preferred above all other food by grain insects, it was deemed a wise move to destroy not only all infested corn and wheat, but also such few samples as showed no outward signs of infestation, but that might contain the pests, either in the larval or egg state, concealed in the kernels.

The bulk of the corn exhibited by all except the colder countries was more or less badly infested, and the wheat as well. The entire corn and wheat exhibits of many of the tropical countries, the good with the bad, were therefore confiscated wherever it was possible to obtain possession of them.

As an example of the work done, a few words in regard to the disposition of some of the cereal exhibits might be interesting.

The first exhibit visited was that of Mexico, in the Agricultural Building, previous inspection having shown that it contained more dangerous species than any other. The grain exhibit of this country, which was one of the largest on the grounds, was displayed in half a dozen large show cases distributed throughout the section, and a large quantity of samples that had not been unpacked, owing to lack of space, were stored in boxes in a small anteroom. Through the courtesy of the commissioner in charge, Mr. Romulo Escobar, the entire exhibit was abandoned for such disposal as should be deemed fit. First, all of the exposed samples were removed, whether infested or not, and after that the boxes of samples in the storeroom were unpacked and nearly all, including the boxes themselves, taken to the crematory and burned. Of the remaining samples, such as were stored in bags and not injured past redemption were placed in the disinfecting tank and treated with bisulphide of carbon. In all, several tons of material, including upwards of a thousand samples of grain, flour, meal, beans, etc., were removed from this exhibit, requiring the services of six men with three carts.

In the Guatemala Building many of the same injurious species were found, conspicuous among which were the Ptinid (*Dinoderus* sp.), the little bean weevil (*Spermophagus* sp.), and the Mycetophagid (*Litargus* sp.). A large quantity of infested material was removed from the exhibited samples, and in an attic storeroom so large a number of damaged samples, consisting chiefly of grain, beans, and other edible products, were found that a truck was necessary for their removal.

The other exhibits visited in which injurious insects were found, and from which more or less infested material was removed, were as follows: Those of Algeria, Brazil, Cape of Good Hope, Ceylon, Japan, Liberia, Orange Free State, Paraguay, Siam, Spain and the Spanish Colonies, and Uruguay, in the Agricultural Building; Costa Rica, the French Colonies of New Caledonia and Indo-China, Tunis, Turkey, and Venezuela, in the government buildings of their respective countries.

The foregoing list includes all the exhibits which contained insects of economic importance. The cereal exhibits of other countries were also visited, but inspection showed that they were either free from infestation or contained only a few of the more common insect pests, rendering no action necessary.

The exhibits in which no insects of a dangerous character were found were as follows: Those of Java, Curaçao, Italy, British Guiana, Johore, Trinidad, Ecuador, Canadá and the other British provinces of North America, Russia, and the other North European countries in the Agricultural Building; those of Greece and Jamaica in the Horticultural and Manufactures Buildings, respectively; and the exhibits of Colombia, Haiti, India, and Ceylon in their respective government buildings.

INSECTS AFFECTING ANIMAL PRODUCTS.

It was not deemed necessary to make an extensive study of the insects affecting woolens, furs, hides, and other animal products on exhibit, as there is comparatively little danger of introductions from abroad. A few species, however, were observed and collected by Mr. Chittenden, all (with possibly one exception) cosmopolitan and widely diffused throughout this and other countries. The following is the list:

Larder Beetle (*Dermestes lardarius* L.).—About Exposition grounds.

Leather Beetle (*Dermestes vulpinus* F.).—Living on dried fish and hides, in Mexican exhibit.

Red-necked Ham Beetle (*Necrobia ruficollis* Fab.).—With the above on dried fish.

Red-legged Ham Beetle (*Necrobia rufipes* De G.).—With the two preceding, on fish and on cheese.

Cheese Skipper (*Piophilus casei* L.).—Accompanying the preceding, on cheese. It also attacks hams and has received special mention in an article in the last number of INSECT LIFE (pp. 170–175) and in the Extracts from Correspondence in the present number.

Trogoderma tarsale Melsh.—Breeding by thousands in silkworm cocoons in U. S. Government Building. A well-known museum pest, probably identical with a European species.

INSECTS NOTICED IN THE FORESTRY BUILDING.

Time did not permit of very extensive collecting in the Forestry Building. From time to time, however, as opportunity offered, Mr. Chittenden visited this building, and a few species, all Coleoptera, were taken, a list of which is furnished herewith. All but two species were picked up from the windows where they were resting, and it is therefore impossible to state the locality from which they were brought. This is particularly true of the first four species, which, with the exception of the Læmophlœus, are all cosmopolitan and might have been brought into the building with foreign exhibits, in packing material or otherwise, or have flown in at the open doors or windows. Several other species besides those mentioned in the list were observed in this

building, but they were all domestic and not known to affect woody plants.

Silvanus advena Waltl., previously treated as No. 6 in the list of grain insects, was noticed in the Forestry Building.

Læmophlœus sp.—An undetermined species not known to inhabit North America, and from its habitus evidently subcortical.

Lathridius minutus L.—Previously mentioned under No. 18.

Coninomus carinatus Gyll.—Probably introduced. Commonly found in old flour barrels. This species might more appropriately have been placed with the grain insects, but its occurrence was noted only in the Forestry Building.

Corticaria fenestralis L. (*deleta* Mann.).—A common and well distributed species.

Melanophila longipes Say.—Well known and widely diffused in the North, where it infests pines and other conifers.

Agrilus sp.—An exotic Buprestid resembling *scitulus* Horn, and possibly from Mexico or Central America. It probably infests deciduous trees.

Cerambycid.—A number of examples of a large Cerambycid or long-horned beetle of a genus unknown in North America, bred out from a stump of *Charisia insignis*, a Malvaceous tree from Argentine Republic. The stump was without bark and the wood was completely ruined by past generations of this species. In their exit the beetles had bored through several large photographs that were attached to the stump.

Platypus compositus Say (?).—A native species of Scolytidæ restricted to the Coniferæ.

Xyleborus affinis Eichh. was bred from a part of the trunk of a leguminous tree, *Erithrina cristigalli*, in the section of the Argentine Republic.

Tomicus cacographus Lec.—A common native species, also a Scolytid, depredating on pine and other conifers.

Phlœotribus frontalis Ol.—Very abundant in the Forestry Building. It is a common species affecting Mulberry and Hackberry.

Hylesinus aculeatus Say.—A well-known American species, attacking ash.

THE HYMENOPTEROUS PARASITES OF THE CALIFORNIA RED SCALE.

By L. O. Howard.

In none of the numerous habitats of the now wide-spread *Aspidiotus aurantii* have true hymenopterous parasites been found except in California. Mr. D. W. Coquillett, in the course of several years' careful study of the insect at Los Angeles in his capacity as field agent of the Division of Entomology, has reared several parasites which he has sent on to Washington from time to time for study. All have been designated to him by their generic names, but none have heretofore been thoroughly studied for descriptive purposes. Sufficient material has now been reared by Mr. Coquillett to warrant the technical characterization of the species, and this paper has therefore been prepared at Prof. Riley's suggestion.

There are, in Mr. Coquillett's material, six distinct species which are undoubted parasites of the Red Scale. Mr. Coquillett also sent in, in

1887, a specimen of a handsome species of the Mymarid genus Alaptus which he had reared from orange leaves infested with the so-called Yellow Scale from San Gabriel. This he at first supposed to be a parasite of the scale insect, but as he afterwards reared a large series of the same species from the little eggs of a Psocid—*Cæcilius aurantiacus*—he concluded that his first specimen probably issued from some unnoticed Psocid egg among the scales on the leaves. He is, without much doubt, correct in his conclusion, and the species is mentioned here simply to warn other investigators against falling into the same error.

The true parasites are as follows:

(1) *Aspidiotiphagus citrinus* Craw
(2) *Coccophagus aurantii* n. sp.
(3) *Coccophagus lunulatus* n. sp.
(4) *Aphelinus diaspidis* Howard.
(5) *Signiphora californica* n. sp.
(6) *Aphycus immaculatus* n. sp.

Owing to the occurrence throughout this article of the names "Red Scale," "Yellow Scale," "*Aspidiotus aurantii*, typical form," and "*Aspidiotus aurantii* var. *citrinus*," it will be necessary to explain that they all refer to the same species, which exists in California in two different forms. The typical *Aspidiotus aurantii*, or Red Scale, is the form described by Maskell from New Zealand, and which also occurs in Australia and in the Mediterranean countries. It was studied by Prof. Comstock in California, in 1880, and described and figured in his report for that year. The name "Yellow Scale" is in common use in California, and refers to a light brownish-yellow variety of the Red Scale which occurs principally in the San Gabriel Valley in California, but which is also found in all other orange-growing portions of the State. This variety differs not only in color, but the dorsal and ventral scales seem to be more firmly cemented together than with the typical Red Scale, and it occurs, moreover, only upon the leaves and fruit, never upon the bark, while the typical Red Scale occurs very abundantly upon the bark as well as upon the leaves and fruit. The typical Red Scale, moreover, seems to be oviparous, while the Yellow Scale is viviparous. The Yellow Scale is mentioned in some California publications as *Aspidiotus citrinus* Coquillett, and Mr. Craw is of the opinion that it is a distinct species and was imported independently from Japan into the San Gabriel Valley. The name *Aspidiotus citrinus* Coquillett was sent to Prof. Riley with a MS. description, but from his own careful study in California and correspondence with Mr. Coquillett, Prof. Riley concluded that the structural differences between the two forms are not constant, and that *citrinus* can only be considered as a variety.

(1) ASPIDIOTIPHAGUS CITRINUS (Craw).

Coccophagus citrinus Craw. Destructive Insects, etc., Sacramento, 1891.
Encarsia citrinus (Craw). R. & H., INSECT LIFE, Vol. IV, p. 168, 1891.

In 1887 Mr. Coquillett sent to Dr. Riley two specimens of a parasite reared from the so-called yellow variety of the Red Scale received from San Gabriel, Cal. In Dr. Riley's absence I wrote him that the insect was a new species of Coccophagus and gave him the manuscript name *C. aurantii*. This insect, or another one, subsequently made some stir in horticultural circles in California, since it was the first known parasite of the Red Scale, and Mr. Alexander Craw, the entomologist of the State Board of Horticulture, was commissioned to examine the orchards in which the parasite occurred and report. He did so, and we understand advised the discontinuance of spraying on account of the abundance of this species. A great deal of newspaper discussion as to the advisability of this course followed, and the State board, in its report for 1891, published a number of letters tending to show the abundance and importance of the parasite.

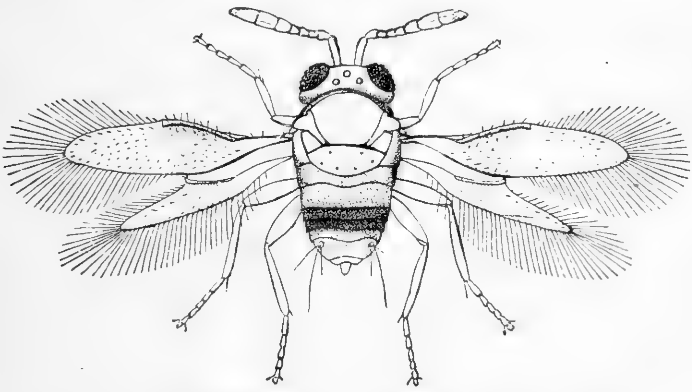

FIG. 6.—*Aspidiotiphagus citrinus* (Craw) greatly enlarged (original).

In 1891 Mr. Craw drew up a report upon the species, under the title "Internal Parasites; discovered in the San Gabriel Valley; Recommendations and Notes," which was published as Bulletin No. 57 of the State Board of Horticulture. In this bulletin he gave a technical description of *Coccophagus citrinus* Craw, accompanied by a figure and a preliminary statement concerning the discovery and work of the insect.

Later in the same year a bulletin was published and distributed by the State Board of Horticulture bearing the title "Destructive Insects, their natural enemies, remedies, and recommendations. By Alexander Craw," etc. On pp. 28 and 29 of the bulletin are given a figure and description of "*Coccophagus citrinus* Craw," both of which differ, in some respects, from the figure and description in Bulletin No. 57.

We suspect that these two descriptions refer to two distinct insects, since two species bearing a strong general resemblance to each other

have been sent us by Mr. Coquillett as reared from the so-called "Yellow Scale," the one having perfectly clear wings, as shown in Mr. Craw's earlier figure, and the other having the fore-wings with a fuscous band, as shown in his later figure. I shall not push this point, however. Mr. Craw may have described two distinct insects under one name. If so, we shall accept his second and presumably more careful figure and description as carrying the name. Mr. Craw's reference of the form to the genus Coccophagus was probably based upon our original determination as sent to Mr. Coquillett, but unfortunately for this reference the form sent us was the clear-winged one, and that which bears Mr. Craw's name has other generic affinities. Mr. Coquillett sent us specimens of the dusky-winged form bred January 18 and 24, and February 2, 1889, from San Gabriel scales and from these specimens, as well as from Mr. Craw's figure, we tentatively placed the species in Fœrster's genus *Encarsia* (INSECT LIFE, Vol. IV, p. 168). More prolonged and critical study, however, renders it evident that a new genus must be erected to contain the species.

Aspidiotiphagus gen. nov.

Female.—Antennæ 8-jointed; scape long, slender; pedicel a little longer than its apical width; funicle joints 1, 2, and 3 increasing in width, but each approximating pedicel in length; club long, distinctly 3-jointed, basal joint shortest, apical joints sub-equal, terminal joint pointed. Lateral ocelli equi-distant from each other and margin of compound eyes. Parapsides of mesoscutum widely separated, very narrow posteriorly, broadening out rapidly towards tegulæ; mesoscutellum like that of Aphelinus, its scapulæ longitudinally elongate and extending forward to lateral widening of the parapsides; metanotum very narrow. Abdomen short, broadly sessile and broadly rounded at tip. Spur of middle tibiæ very slender, as long as the short, first tarsal joint. Fore wings long, narrow; submarginal and marginal veins sub-equal in length; post-marginal lacking; stigmal very slight and parallel with costa, situated at half the wing length and exactly opposite to the termination of thickening of hinder margin of wing; this being also the widest point of the wing; cilia of wing surface rather sparse, a clear rounded space immediately below stigma, and a narrow clear line around margin; marginal vein bristly; marginal cilia very long, longer than wing width, those on costal margin just beyond stigma nearly as long as those on hind margin. Hind wings very narrow, with long marginal cilia and but one row of discal cilia on outer third; marginal vein ending abruptly and extending up apparently beyond costa.

Differs from Coccophagus in wings and from Encarsia in antennæ and wings.

ASPIDIOTIPHAGUS CITRINUS (Craw).

Female.—Length 0·58 mm; expanse 1·16 mm; greatest width of fore wing 0·09 mm. Antennæ light yellow-brown; eyes black, ocelli bright-red; head yellow; occiput dark brown; pronotum dark brown; mesonotum yellow; metanotum yellow-brown; abdomen brown; legs uniformly dusky yellow; wings with marginal vein dark fuscous, and a broad fuscous band extending directly across wing from marginal vein as a base. Spiracular hairs on pre-anal abdominal joint very long. Thorax somewhat wider than head or abdomen, these being sub-equal in width.

Redescribed from 14 ♀ specimens reared January 18 and 24, February 2, and March 13, 1889, by D. W. Coquillett from *Aspidiotus aurantii* Maskell, var. *citrinus*, from San Gabriel, Cal.

There are four specimens of this species in the collection of the Department of Agriculture, reared January 6, 1881, from *Diaspis bromeliæ* Kern. on *Ananassa sativa* in the greenhouses of the Department.

(2) COCCOPHAGUS AURANTII n. sp.

This is the original clear-winged form referred to in the preliminary remarks under the last species. We have but two specimens, and these were reared by Mr. Coquillett, May 9, 1887. It is the species to which

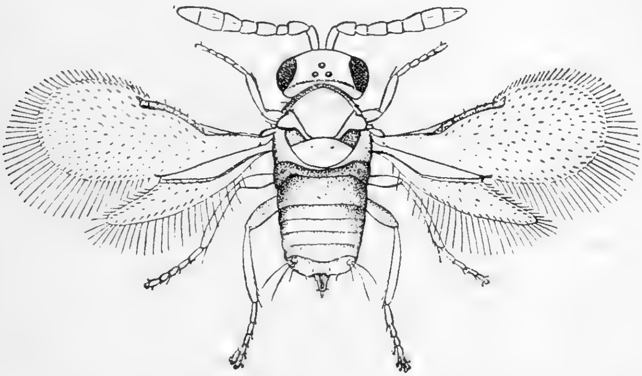

FIG. 7.—*Coccophagus aurantii* n. sp.; greatly enlarged (orginal).

we gave the above name in MS at the time of its first receipt. It differs from the typical Coccophagus principally in the long fringe to the hind wings; but it hardly seems necessary to erect a new genus for it.

COCCOPHAGUS AURANTII n. sp.

Female.—Length 0·7 mm.; expanse 1·16 mm.; greatest width of forewing 0·18 mm. Joint 1 of funicle shorter and narrower than pedicel and than joint 2, which is subequal to pedicel in length and width; joint 3 shorter than 2. General color light brownish yellow; occipital line, margin of pronotum, scapulæ, outer edge of me tanotum, abdomen, especially lateral margin, darker; antennæ and legs light fuscous; eyes black, ocelli red; wings hyaline, veins slightly dusky. Fore-wings with disc densely, finely, and uniformly ciliate, costal margin with very short marginal cilia beginning at stigma, growing gradually longer at tip of wing and on lower outer margin becoming half the width of wing; broadest portion of wing beyond stigma; hind wings with two rows of discal cilia and an incomplete third row on outer third; cilia of lower margin somewhat longer than greatest wing width.

Described from two female specimens reared May 9, 1887, by D. W. Coquillett from *Aspidiotus aurantii* var. *citrinus* from San Gabriel, Cal.

Specimens of this species occur in the collection of the Department of Agriculture, reared from the following species of Coccidæ: *Aspidiotus ancylus* Put. var. on Linden, District of Columbia; *Mytilaspis citricola* Pack. on Orange, Florida; and *Aspidiotus pini* Comst. on *Pinus rigida*, Ithaca, N. Y.

This form may be at once distinguished from the preceding by the fact that its fore-wings are twice as broad in comparison to their length, are perfectly clear, and have no very long cilia on their anterior margin. It is a somewhat larger species and lighter in color.

(3) COCCOPHAGUS LUNULATUS n. sp.

In November, 1892, Mr. Coquillett sent to the Division some orange leaves thickly covered with the Red Scale for use in the collections which were then being prepared for the Chicago Exposition. These leaves were carefully mounted, but as it would be some little time before they would be needed for the boxes, they were placed in a glass jar to ascertain whether they were parasitised. A week later a single parasite issued which proved to be a typical Coccophagus (not an aberrant one like the preceding species), but belonging to an undescribed species. It is a very handsome form and is readily distinguished by its coloration no less than by its structural features from any of the other Red Scale parasites.

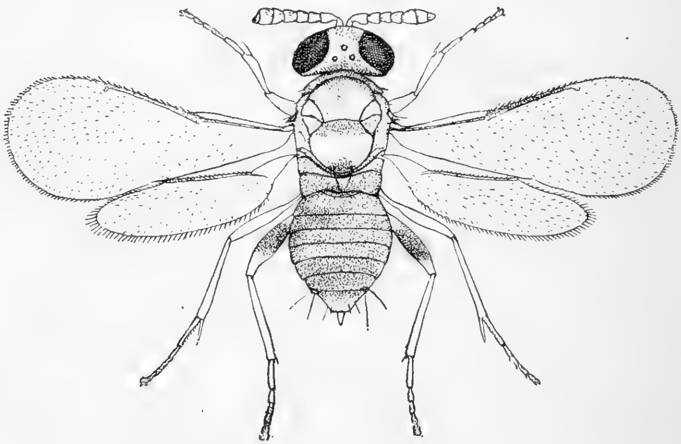

FIG. 8.—*Coccophagus lunulatus* n. sp.; greatly enlarged (original).

COCCOPHAGUS LUNULATUS n. sp.

Female.—Length, 0·93 mm.; expanse, 2 mm.; greatest width of fore-wings, 0·39 mm. Head rather coarsely punctulate, opaque; mesonotum very finely shagreened, somewhat glistening; mesoscutellum with apical bristles very long; abdomen smooth, shining. General color black; apical three-fifths of mesocutellum bright orange, with an irregular black spot at tip and with the dividing line between the orange and black irregular; tegulæ black; antennæ with the scape black and the flagellum dark fuscous; front legs, including coxæ, light orange yellow, considerably lighter than the mesoscutellum; middle and hind coxæ and hind femora black, middle and hind trochanters, tibiæ and tarsi and middle femora light orange yellow. Wings hyaline, veins dark brown, marginal cilia very short.

Described from one female reared December 5, 1892, from *Aspidiotus aurantii* received from D. W. Coquillett, Los Angeles, Cal.

(4) APHELINUS DIASPIDIS How.

APHELINUS DIASPIDIS How. Annual Report U. S. Department of Agriculture, 1880, p. 355.

This species was first reared from *Diaspis rosæ*, received in 1880 from Fort Reed, Fla. Later, specimens were received, reared from the same species of scale, from Santa Barbara, Cal. Specimens were received from Mr. Coquillett in 1892, which were found upon leaves infested with *Aspidiotus aurantii* received from Santa Ana, Cal., in July and August. Some specimens were observed by Mr. Coquillett in the act of ovipositing in the scales.

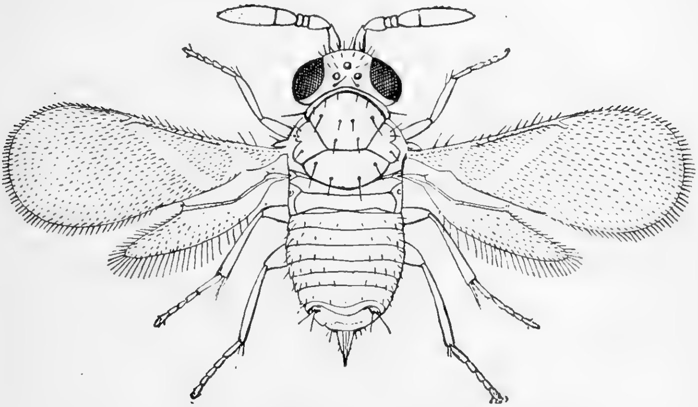

FIG. 9.—*Aphelinus diaspidis* How.; greatly enlarged (original).

This species is larger than either of those previously described, and is bright yellow in color. It is probably the "golden Chalcid," referred to by Mr. Craw in his article in the *California Fruit Grower* of February 28, 1891.

(5) SIGNIPHORA OCCIDENTALIS n. sp.

In his work on Orange Insects published at Jacksonville, Fla., in 1880, Mr. W. H. Ashmead erected the genus Signiphora to contain a species which he called *S. flavopalliata* and of which he had reared two specimens from *Aspidiotus citricola* Pack., the Purple Scale of the Orange. Since Mr. Ashmead's volume is now very rare, we reprint his generic characterization:

SIGNIPHORA Ashmead.

Form, robust, polished, or shining; head wider than thorax, ocelli 3, triangularly arranged; labial palpi 3-jointed; antennæ inserted in front between the eyes, rather close together, 3-jointed; first joint or scape long; second small and round; third large and fusiform; thorax broad, not quite as long as abdomen; legs setaceous, with five-jointed tarsi, first joint longest; hind tibia in place of the usual spine furnished with an anomalous five-lobed appendage, in this respect differing

from any known Chalcid. Abdomen somewhat sharply pointed and ending in a rather long ovipositor. Wings well rounded and strongly ciliated. Coxæ almost touching.

In the Annual Report of the U. S. Department of Agriculture for 1880 (p. 371), we called attention to this remarkable insect and stated that Mr. Ashmead was probably in error in locating the "anomalous five-lobed appendage" upon the hind legs instead of upon the middle legs, since it is probably homologous with the apical spur of the middle tibia so strongly developed in the Aphelininæ and Encyrtinæ.

Subsequent rearings of specimens from *Mytilaspis gloverii* and *Aspidiotus cydoniæ* from Florida, from an Aleyrodes on oak from California, by Mr. Coquillett, and from *Aspidiotus aurantii* by the same gentleman, as well as the deposit of one of Mr. Ashmead's types in the collection of the U. S. National Museum, have enabled us to make a careful

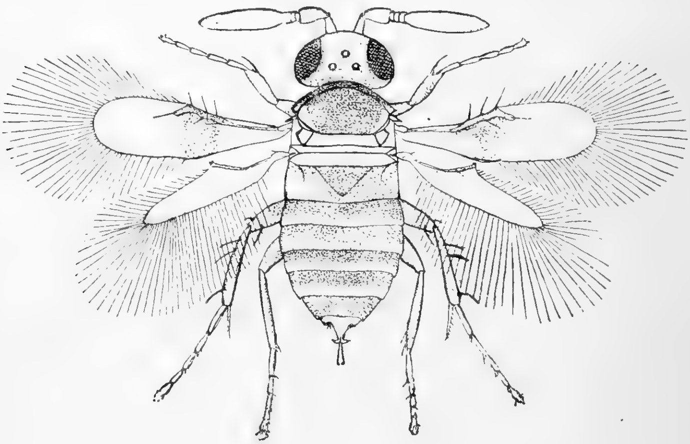

FIG. 10.—*Signiphora occidentalis* n. sp. greatly enlarged (original).

study of this peculiar genus. It differs so markedly from all other known Chalcididæ that it must be placed in a subfamily by itself, and we therefore propose for it the subfamily name *Signiphorinæ*. Several important points in the structure of the insect were not made out by Mr. Ashmead, and with more abundant material at our disposal we have drawn up a somewhat closer description of the genus and have characterized the subfamily, adding a description of the new species reared by Mr. Coquillett from the Red Scale.

SIGNIPHORINÆ, Subfam. nov.

Tarsi 5-jointed. Apical spur of middle tibia long and with *several long spines on inner edge*. Pronotum reaching nearly to tegulæ. Mesoscutum entire. *Mesoscutellum represented by a narrow transverse band.* Mesopleura short, sharply divided from metapleura. *Metascutum with a differentiated triangular central sclerite*, resembling the normal mesoscutellum. Antennæ at most 8 jointed. Ovipositor cleft of female abdomen extending back to 3d segment.

SIGNIPHORA Ashmead.

Type, S. flavopalliata Ashm. Orange Insects, 1880, p. 30.

Body robust; ocelli 3, situated in triangle. Antennæ inserted at border of clypeus, 6-jointed; scape reaching nearly to top of head; pedicel large, nearly as long as scape; funicle joints 1, 2, and 3 very small; club very long, undivided. Face round; mandibles strong, bidentate; labial palpi rudimentary; maxillary palpi 3-jointed. Fore-wings rather broad and short; submarginal and marginal veins subequal in length; marginal thick; stigmal thinner and curved; marginal and stigmal veins with several long, stiff bristles; no discal cilia; marginal cilia very long and delicate, beginning on costal margin just beyond stigmal and extending around to a point opposite the stigmal. Hind-wings narrow and with very long and delicate cilia beginning beyond marginal vein and extending around nearly to hinder base of wing. Middle tibiæ with a number of stout bristles, apical spur as long as first tarsal joint and furnished on inner edge with five or six long bristles at regular intervals; front and hind legs unarmed. Abdomen broadly sessile, rounded at tip; ovipositor of female somewhat extruded, apical spiracles facing ventrally; male penis long, cleft at tip.

SIGNIPHORA OCCIDENTALIS n. sp.

Female.—Length, 0·53 mm.; expanse, 1·2 mm.; greatest width of fore-wing, 0·09 mm. Antennal scape robust, reaching to middle of eyes; pedicel large, stout, rather more than one-third as long as scape; funicle joints 1, 2, and 3 subequal in diameter, very small, together only a little over one-third length of pedicel and considerably less than the tip width of pedicel; increasing in length from 1 to 3; club nearly as long as scape and pedicel together, long oval when seen from side, twice as wide as pedicel, narrow with parallel sides when seen from above, scarcely wider than funicle joint 3. Marginal vein with 6 strong bristles, stigmal with one, submarginal with one. Middle femora with a strong spine near inner side of tip, tibiæ with three strong external spines, two near base and one near tip. Color (from balsam-mounted specimens only): Head, pronotum, metanotum and abdomen, dark brown, nearly black, eyes dark red; mesonotum bright lemon-yellow; all legs and antennæ fuscous; mouth parts light-brown, mandibles tipped with black; wing veins fuscous; fore-wings with an indefinite fuscous patch occupying entire disc except at base and apical fourth.

Male.—Resembles female, except that it is rather larger and has the entire mesoscutum brown, leaving the yellow band to include mesoscutellum and metascutum.

Described from two ♀, three ♂ specimens reared by D. W. Coquillett, from *Aspidiotus aurantii* var. *citrinus*, from San Gabriel, Cal., May 30, June 1 and 3, 1887.

(6) APHYCUS IMMACULATUS n. sp.

The sixth of the Red Scale parasites belongs to another subfamily, the Encyrtinæ. Mr. Coquillett reared two specimens of this form from typical specimens of *Aspidiotus aurantii* October 11, 1887, and unfortunately mounted both specimens in balsam. The species has not been reared since, and hence can not be properly studied from dry mounts. Enough of its characters, however, are brought out in the balsam mounts to separate it from all described species. It is possible that this is the adult of an interesting parasitic larva which Mr. Coquillett

has studied, and of which he writes that, as it increases in size, it causes the dorsal scale to separate from the ventral so that the adult escapes from beneath the scale instead of gnawing a hole through it.

APHYCUS IMMACULATUS n. sp.

Male.—Length, 0·55 mm.; expanse, 1·3 mm.; greatest width of fore-wing, 0·21 mm. Antennal scape slightly widened below, pedicel nearly half as long as scape, club as long as three preceding funicle joints together, funicle joints with hairs rather longer than length of each joint; mesoscutum with punctation longitudinal down

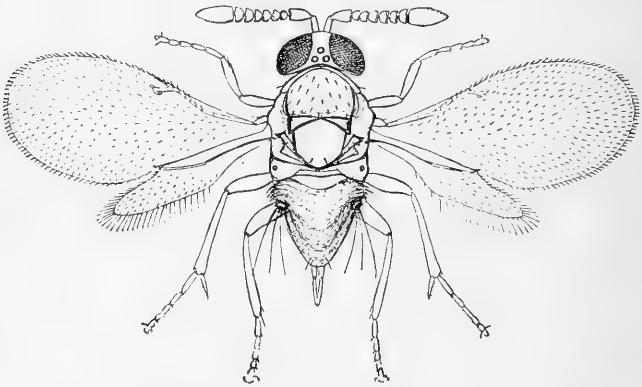

FIG. 11.—*Aphycus immaculatus* n. sp., greatly enlarged (original).

middle, transverse each side; metascutum with short longitudinal punctation; scapulæ and visible portions of metascutum with lengthy transverse punctation. Hairs from third abdominal spiracles extending beyond tip of abdomen. Color uniform dark yellow brown, head light yellow, all legs dusky; antennæ uniformly dusky yellow; wings hyaline.

Described from one balsam-mounted ♂ reared from typical *Aspidiotus aurantii*, by D. W. Coquillett, at Los Angeles, Cal., October 11, 1887.

THE INSECT COLLECTIONS OF THE COLUMBIAN EXPOSITION.*

By F. H. CHITTENDEN.

Several accounts have appeared of the collections of insects exhibited at the World's Columbian Exposition, but, as only one of these has apparently made any attempt at completeness, it has been thought desirable to present to the readers of INSECT LIFE, as a matter of record, a more complete list of these exhibits.

The exhibit of the Division of Entomology of this Department was displayed in the U. S. Government Building, and as a complete catalogue of it, including all except a series of eight large cases of forest tree insects, which was originally prepared to form part of the Forestry

*A report made to the Entomologist of the exhibits other than that of the U. S. Department of Agriculture.

exhibit, has been issued as Bulletin No. 31 of this Division, no further comment is necessary. Copies of this bulletin were kept for distribution on the desk of the writer, who was in charge of the exhibit from the completion of its installation till near the close of the Fair, and whose duty it was to explain special features of the entomological exhibit and answer questions relative to insect injury and the means to be employed for the prevention and destruction of injurious species.

Another collection exhibited in the Government Building was that of the United States National Museum. It consisted of thirty-two large cases designed to illustrate the classification of the families of American insects, using the word in its widest sense. This collection was prepared under the direction of Prof. Riley by Prof. J. B. Smith, and was purely educational in character. The different family characters were given on printed labels, and illustrated by full series of specimens and drawings, many of the latter original and unpublished. This, as well as the major portion of the exhibit of the Department of Agriculture, will be preserved in the National Museum.

The Division of Ornithology and Mammalogy of the Department of Agriculture also exhibited a few insects in this building, including two cases of insects commonly eaten by the Crow, Crow Blackbird, Cedar-bird and King-bird.

In the Illinois State Building, the Illinois State Laboratory of Natural History, and the University of Illinois made a very creditable display, about one hundred and twenty-five cases in all being exhibited. For this, two rooms and their outer walls were used. The first of these was fitted up as the office of the State Entomologist and his assistants, being supplied with desks and tables, books and book-cases, typewriter, printing-press, microscopes, and other office appliances. The smaller represented in miniature an insectary or rearing-room, and was furnished with vivaria and the customary apparatus used in rearing insects.

On the book-shelves there were about 1,400 volumes, constituting a third of the entire entomological library of the State laboratory.

Of the preserved specimens the following were exhibited:

A large series of the commoner insects of Illinois, arranged in systematic order, well mounted and labeled and made up of new specimens gathered in the field expressly for this purpose. This included nine cases illustrative of the distribution of Illinois butterflies.

A part of the students' reference collection of the University of Illinois.

Five cases of insects, constituting a series which is furnished by the State laboratory to the high schools of the State.

An exhibit of noxious insects, including a series of about two hundred species that injuriously affect the Apple, and similar smaller cases of insects injurious to Corn, Wheat, the Strawberry, and other crops.

The more important species were accompanied by excellent original colored illustrations of the adult insect, the work of Miss Hart.

One of the best features of the Illinois exhibit was a series of eleven cases representing by specimens the average food of a robin for a year. There were also smaller series of the insects forming the food of other birds, and of fishes.

This exhibit was in the constant charge of a representative from the State laboratory. It was originally intended to carry on here a part of the routine entomological work of the laboratory, of rearing and caring for insects, experimenting, and answering correspondence, but lack of funds prevented.

There was also on exhibition, in a different quarter of the building, a small series of cases designed for class work, from the Northern Normal School of Illinois.

In the Agricultural Building, in the Office of Experiment Stations, a prominent place was devoted to its entomological exhibits, which were composed of contributions from entomologists of different stations.

West Virginia contributed fifteen cases, chiefly of wood and bark damaged by bark and timber beetles of the family Scolytidæ. These specimens were selected with great care and showed the characteristic work of the different species. A catalogue of these insects, most of which were represented in the exhibit, was issued by the station, but was not available to the visitor.

New Jersey exhibited fourteen cases of the injurious insects which furnished the text of the special entomological bulletins of the station. This included insects injurious to the Cranberry, Squash, Grape, Blackberry, and Sweet Potato, a special case of the "Rose-Bug," and four cases designed to illustrate methods and apparatus. A feature of this exhibit was the specimens of plants showing the nature of the injury done by the insects. The insects were exhibited in large series, neatly and artistically arranged and fully labeled, the collection being on the whole the most appropriate of all in this exhibit.

Maine made a unique exhibit of five cases of biologic material, consisting of microscopic slides, vials, and pinned specimens, together with colored illustrations of the life-history of the Apple Maggot (*Trypeta pomonella* Walsh). A copy of the station bulletin on this subject was attached to one of the cases in a convenient manner for reference.

Of the other stations contributing material, Mississippi had one case of insects which have received special study at that station, another of North American Myriopoda, and a third of species injurious to cotton. Nebraska had three cases of insects affecting the Sugar Beet, the remainder of the contribution of this station being exhibited in the Forestry building. The Cornell station of New York contributed two cases, evidently designed to show the Comstock block system and biologic vials. Kansas was represented by six neatly arranged cases of insects affecting the Apple. South Dakota showed eight

cases of "tree-claim insects." Iowa exhibited twelve cases and Louisiana three of different orders, chiefly adults. The exhibit of the Colorado station consisted of eight cases of biologic material and showed evidence of original observations, but which while excellent in its way was somewhat out of place as showing the work of an experiment station. Oregon exhibited two cases labeled "some Oregon pests" and a third of "a few Oregon insects," the latter chiefly Coleoptera.

In addition to these there were four cases of silk-worm moths, both foreign and native, together with blown larvæ, but with no indication of the contributor or the source from which they were derived.

It is to be regretted that several of the last-mentioned contributions were inappropriate in this exhibit and were insufficiently labeled, there being nothing in some cases to indicate the station making the contribution except the minute locality labels attached to the pinned specimens. It is also a matter of regret that the contents of several cases were completely ruined in transportation.

A part of the Experiment Station exhibit consisted of a series of frames, labeled "original illustrations," contributed by different States, in the main original, but composed in part of illustrations from other sources than the station exhibiting them. There was also an exhibit of collecting and mounting apparatus, a series of models showing the internal anatomy of insects, and a small exhibit of insecticides and insecticide machinery, including eleven jars of kerosene emulsion prepared according to different formulæ, the latter contribution from Mr. H. E. Weed, of the Mississippi station.

A large exhibit, composed principally of named Coleoptera and Lepidoptera, but with a fair representation from other orders, was shown in the Minnesota section of the Agricultural Building. It consisted of forty-eight large cases including, besides the above, a series of the various species of grasshoppers collected by the use of a "hopper-dozer," nine cases of economic species in their different stages, and two cases of galls. The installation of this exhibit was most unfortunate, the entire upper half of three cases having been placed so high as to render it impossible for the average visitor to read the labeling.

In the Canadian section was exhibited a very good series of the Lepidoptera of the Dominion, each species being represented usually by but one or two specimens, and smaller series of Coleoptera and Hymenoptera.

In the Austrian section of this building, and in the gallery of the Manufactures and Liberal Arts Building, there were small series of jars of alcoholic material, very neatly arranged, with printed labels, and showing the transformations of one or more large and conspicuous species of the different orders of insects.

Smaller entomological exhibits were displayed in this building by Java, British Guiana, and Japan.

In the Forestry Building a few interesting collections were displayed. One of the best of these was that of the experiment station of West

Virginia, which differed but little in character from that exhibited in the Agricultural Building.

Russia was represented by a very creditable display from the Institute of Forestry at St. Petersburg, consisting of about forty cases of samples of trees destroyed by Scolytidæ. Twenty samples of the work of *Scolytus rugulosus*, a species common to both hemispheres, were shown, from which an idea could be obtained of the variation in the work of one of these insects in different kinds of wood.

In the German section a small exhibit of some of the principal forest insects and their work was displayed, together with photographs showing the effects of their ravages.

Nebraska furnished about forty cases including, besides insects injurious to forest and shade trees, a considerable number which affect various farm crops, and which should have been allotted space in the Agricultural building.

Michigan also exhibited a series of nineteen cases of the commoner forest-tree insects of that State, the species represented chiefly by pinned adults, with much unnecessary duplication.

The largest foreign entomological exhibit was that made by Japan in the Manufactures and Liberal Arts Building. This consisted of nearly two hundred cases of all orders well mounted and, barring slight injury to a few cases in transportation, in excellent condition. This collection, although arranged in approximately systematic order, was unnamed.

An interesting and unique exhibit in this building was that of the Chicago Varnish Company of insects imbedded in gum copal, mostly from the north coast of Africa and New Zealand. About thirty specimens of the gum were displayed, and the insects, although made up chiefly of Coleoptera, included ants, cockroaches, flies, termites, a spider, and both Homoptera and Heteroptera. The beetles were mostly Longicorns and Lamellicorns, but included also Scolytidæ, Carabidæ, Cleridæ, and Lucanidæ.

In the gallery of this building, in the educational section, several exhibits were displayed. The Agricultural College of Michigan contributed a lot of boxes made up from material gathered by students during their college course, and a group of photographs of graduates who had been engaged in teaching entomology or had held office as entomologists in experiment stations. The New South Wales exhibit was contributed by the Macleay Museum of Sydney University, and was composed of a dozen cases, equally divided between the Coleoptera and Lepidoptera, mostly well mounted, identified, and labeled. The Mexican exhibit was made up of different orders, the specimens mostly in poor condition and unlabeled. Japan and Germany also showed specimens of the work done in their schools, the latter country particularly excelling in the amount of biologic material.

In the Anthropological Building there were two exhibits of Lepidoptera, that of Colorado, contained in seventy-two cases, and one owned

by Mrs. J. G. Sorup, a Chicago collector. The latter collection was contained in over fifty cases, and included both native and exotic species. Brazil contributed to the exhibit of this building a small series, mostly of showy forms in poor condition..

In the German Government Building, unfortunately in an obscure corner of the basement, a creditable display of insects destructive to forest insects was made by the Waldhof Sulphite Company. Complete catalogues in German and English were furnished.

In the Colombian Building, in an ordinary commercial show case, there was displayed a lot of showy and brillant butterflies, with a few dragon-flies, beetles, and other forms, making a very pretty display. As with others of the exhibits of South and Central America, none of them were named, and no attempt had been made at classification in arrangement.

India in her Government Building displayed four cases of Lepidoptera from the Himalayas.

Costa Rica exhibited ten large colored plates of Lepidoptera, evidently the efforts of an amateur, and a similar number of cases of insects of different orders in very indifferent condition.

Kansas had a small lot of boxes of Lepidoptera in her State building.

In the Women's Building there was a small lot of boxes of Lepidoptera from Wisconsin, and some original drawings by Mrs. A. B. Comstock and others.

In addition to the galls shown in entomological exhibits, some good collections were displayed in the botanical sections. Of these Germany exhibited two in the educational section of the Manufactures Building; and the third was located under the dome of the Horticultural Building.

Illustrations of insects, drawings, paintings, wood-cuts, lithographic plates, etc., formed a prominent part of many exhibits of art work of schools, colleges, and other institutions.

Quite a quantity of material was brought from some of the southern countries, but was so badly injured in transportation as to be utterly unfit for exhibition. Of such were a number of cases from Costa Rica and Colombia, Guatemala and Ecuador.

A few exhibits, small in extent and importance, were reported by different visitors at the Fair, but as they were not seen by the writer no account is given. These included a series of fossil insects, and insects found in amber shown in the Mining building, and a few boxes from New Mexico in the gallery of the Manufactures building.

Spraying machines and other apparatus for the destruction of injurious insects were displayed in various other exhibits besides those already mentioned. Prominent among them were the exhibits of Vermorel and several other companies in the Horticultural Building, those of the Deming Company in the same building and in Machinery Hall, and that of the Nixon Nozzle and Machine Company.

In the Austrian section of the Agricultural Building five different Dalmatian firms contributed samples of insect powder and chrysanthemum flowers used in its preparation.

Large silk exhibits were made by Japan and France in the Manufactures Building and by the U. S. Department of Agriculture in the Government Building. Smaller exhibits were made in the Agricultural Building by France, Mexico, Brazil, Greece, Algeria, and Russia, and still others were distributed about the grounds, notably in the Turkish and Columbian pavilions and in several State Buildings. The best of these exhibits showed the silk-worm in its different stages, the eggs on cards, blown larvæ in their successive moults, chrysalids, cocoons, and adults, and the silk, raw and manufactured.

There were large domestic and several foreign exhibits of bees, honey, and other apiarian products and appliances, which have received notice in a more extended report elsewhere in this number.

THE APIARIAN EXHIBIT AT THE COLUMBIAN EXPOSITION.*

By Frank Benton.

Seventeen States and Territories and twenty-three foreign countries and colonies made entries of apiarian products or implements used in apiculture. But ten States, namely, California, Iowa, Illinois, Indiana, Minnesota, Michigan, Nebraska, New York, Ohio, and Wisconsin, made displays worthy of special notice. Seven other States and Territories had small entries of honey or wax among their general exhibits of agricultural products, while the remainder of the Union, embracing some very excellent honey-producing areas, was wholly unrepresented. The exhibits were, however, creditable, and though no more than half what our country should have shown, they were infinitely superior to those of any other country, taken as a whole, represented at the Fair, not merely on account of their size, in which respect it would hardly be fair to compare with them the exhibits of foreign countries which by reason of their distance from Chicago were placed at a disadvantage, but the character and quality of the exhibits—a sure index of the plane to which apiculture had attained in a given country—was, in the case of the United States, such as to warrant quite a degree of patriotic pride on the part of American bee-keepers.

Looking at apiculture in the foreign departments of the Fair anyone familiar with the condition of the industry abroad, especially in the leading countries of Europe, could not fail to be struck by the fact that it was very inadequately represented, that in truth hardly a foreign country that made entries in this line had done itself justice, while many that might have made excellent exhibits were not represented at all. This

* Report of observations made during October under instructions from the Entomologist.

is in striking contrast to the character of the apicultural exhibit of the United States at the Paris Exposition of 1889, where the finest of all the exhibits was unquestionably that made by the United States, unprejudiced authorities, both French and German, conceding this.

GREAT BRITAIN AND COLONIES.

The collective exhibit in apiculture made under the British flag contained by far the finest and largest show of honey made by any foreign country. Although the United Kingdom herself had a creditable display of honey, it was chiefly due to one province alone in Canada—the province of Ontario—that the exhibit as a whole could fairly rank with those made by several of our States.

Great Britain and Ireland.—For the largest and best arranged display of honey from Europe this country deserves the first place. This exhibit was made by the British Bee Keepers' Association and the societies affiliated with it, about one hundred members sending 5 to 50 pounds each, showing different varieties and qualities. The aggregate of 1,000 to 1,200 pounds was all placed in small glass jars neatly labeled with the association label, the name of the producer, the locality, and the kind of honey being given. The British Bee Keepers' Association examines candidates for the title of expert bee-keeper and grants certificates of three grades to successful competitors. Specimen pages of the works used in these examinations and copies of the certificates were on exhibition.

Canada.—A magnificent display of both comb and extracted honey, nearly filling a case 25 feet long, 5 feet wide, and 8 feet high, was sent from the province of Ontario, there being forty-nine exhibitors. Many experts were undecided as to whether the palm should be given to this exhibit or to some of the State exhibits. The Ontario comb honey was particularly fine, the sections being well filled out to the wood, combs even, and wood and combs clean. The show of extracted honey was good, there being also many varieties. Comb foundation of good quality and reversible honey-extractors were exhibited by the Goold, Shapley & Muir Company, of Brantford.

Ceylon.—A bottle of honey gathered by the great bees of India, *Apis dorsata*, was of a beautiful golden color and most excellent flavor. The wax from the same source was also good.

New South Wales.—Some eighty jars of honey from this colony were on exhibition in the Agricultural Building. The style of package was not very attractive, but one-half of the jars contained honey that was clear, liquid, and of good color.

GREECE.

Four lots of honey, about 250 pounds, from this Kingdom were shown. Two were labeled Attica, one Mount Hymettus, and one Cerigo. All were in large jars, crystallized, and presented a brown appearance.

The flavor reminded one of wild thyme, but the taste of pollen was so strong as to render the honey unfit for table use. Modern methods in apiculture have not gained a foothold in Greece, and the custom is still to crush the combs and strain the product, which is then transported to market in goat skins.

ITALY.

As far as regards attractiveness the honey exhibit from Italy is entitled to first rank among those from Europe, and in quantity it was second only to Great Britain. Much credit is due to Signor Carlo Passerini, of Turin, who had 500 to 600 pounds of honey, 150 pounds of which was in glass jars neatly labeled, the whole presenting a very fine appearance. He also exhibited some fifty boxes of honey caramels, and liquors prepared with honey as one of the ingredients. G. Bonafede, of Palermo, Sicily, showed some 60 pounds of light-colored extracted honey in white glass jars, labeled as orange honey, but which had a strong biting flavor—conclusive evidence that the bees had not confined themselves to orange blossoms alone, the flavor of pure orange honey being very mild and delicious. An extractor of practical construction was also shown by Mr. Bonafede.

JAPAN.

A small but interesting exhibit was made by Japan. One of the simplest native hives, built in sections, placed one above another to the number of six, was shown. While not presenting any features that could be advantageously adopted here, it is of especial interest to American bee-keepers, because it is constructed on the principle of the shallow, horizontally-divided section hive, and, being one of the oldest Japanese hives, antedates by a few centuries the patent granted by our Government on this feature in bee-hives.

A jar of honey and a box of bleached wax were included in the exhibit. The former sells at about 5½ cents per pound in Japan, the latter at 18 cents.

American and European apiarists know little regarding the honey bees of Japan, and the case containing a queen, drones, and workers of one of the cultivated varieties was of especial interest. Though the specimens were damaged by moisture it was easy to see that the bee is a true *Apis*, but differing considerably in size and markings from all of the European and Western Asiatic races of honey bees. They resemble, as near as could be determined, the Carniolan race more than any other, but the workers and drones are smaller and the former show yellow bands, which true Carniolans do not possess.

MEXICO.

Quite an attractive case of honey and wax of various colors and qualities and a native hive—a section of the bark of a palm tree, comprised the exhibit from Mexico. Some of the honey reminded one in

its flavor of orange groves, while several were labeled Agave honey (*miel de maguey*). Altogether the exhibit would lead one to regard Mexico as a favorable region for this pursuit.

RUSSIA.

The Russian exhibit was more complete than any other foreign representation, including, as it did, besides honey and wax, also hives and models of hives, various implements used in the apiary, comb foundation, and products of wax or honey. Many of the models and implements were sent by the Agricultural Museum of St. Petersburg. The only full-sized frame hive in the collection, shown by the Russian Society of Apiculture, was essentially a two-story Langstroth hive, the size of the frame being about that of the Quinby hanging frame. Russia has of late copied much from French Switzerland in apicultural matters, and this country has adopted with eminent success many American methods. Langstroth's work, as revised by the Dadants, has recently been translated into Russian. The extracted honey shown by Russia was not of a very high grade, but some sections of comb-honey were very fine, both in quality and appearance. The sections were made of strips of glass.

OTHER COUNTRIES.

Among the foreign exhibits the following-named countries were represented by entries which may be briefly passed over: Argentine Republic, wax of various grades; Austria, wax candles; Brazil, dull gray wax and candles of dull yellow wax; Costa Rica had seven entries, noticeable among which was comb honey in American one-piece wooden sections, the only ones in any of the foreign exhibits except those of Canada; Ecuador, wax; France, represented by Algeria, with four jars of honey and two separate lots of beeswax; also honey from the penitentiary of Tledes Pins, New Caledonia, and honey from Annam-Tonkin; Germany, two entries of products; Guatemala, white, gray, and yellow wax, four jars of honey from cane (labeled "miel de cana"); Haiti, one dozen jars dark liquid honey; Siam, one entry only; Spain had but one jar of honey on exhibition, but that was of exquisite quality; the Spanish colony, Porto Rico, showed several specimens of wax of indifferent quality; Turkey, one dozen specimens of wax broken from larger cakes, not properly cleansed but otherwise good; Uruguay, yellow wax in bulk and very fine white wax candles; Venezuela, a half dozen jars of strained honey of poor quality and four cakes of wax ranging from fair white to black.

THE UNITED STATES.

The special State exhibits in apiculture were shown in large glass cases located on the balcony in the southeast part of the Agricultural Building. There were eighteen of these cases, several of which were 15 feet, and the rest, 25 feet long, 5 feet wide, and 10 feet high.

California was represented by one case containing comb and extracted honey, the exhibit, owing to difficulty in securing appropriations, being neither as large nor as good as might have been expected from such a honey-producing State, where some of the most skillful specialists are located.

Iowa had one case containing in the center a pyramid built up of pound sections filled with comb honey and two smaller pyramids of jars of extracted honey. The word "Iowa" in capital letters worked out in comb honey by bees appeared in front. E. Kretchmer had well-made hives and implements on exhibition.

Illinois.—This exhibit filled four large cases, one case containing 2,200 pounds of comb honey in sections built up to represent a castle; a second was filled with a competitive display of comb honey, on the front in letters of comb honey the motto: "In God we Trust," and the name "A. Coppin, Wenona, Ill.," whose bees worked the letters. The show of extracted honey filling one case was excellent, while the wax which occupied the fourth case was of fine quality and skillfully wrought. Most of it was contributed by Ch. Dadant & Son. The same firm exhibited their fine comb foundation. The Porter bee-escape was also shown.

Indiana had in a single case a creditable exhibit, including comb and extracted honey, wax, and a drink prepared from honey. A. G. Hill had quite a collection of apiarian implements, hives, etc.

Minnesota.—Although this State produces as fine honey as any in the Union and has able bee-keepers, the exhibit, like those of several other States, was not a fair index of this. It consisted of comb and extracted honey in one case.

Michigan.—A single case contained as fine extracted honey as was to be seen on the grounds, and some of the comb honey was slightly excelled, if at all. Wax and foundation of good quality were shown. Bingham smokers and knives were included in the exhibit.

Nebraska.—Comb and extracted honey, wax flowers and figures very skillfully wrought, and the largest collection of mounted honey plants shown occupied the Nebraska case, while back of it were several nuclei with Italian bees in them.

New York had a large and very fine exhibit of comb and extracted honey, quite a number of apiarian supplies, and several colonies of bees. The latter stored some 40 pounds of comb honey per hive while on the grounds. The supplies, excellent in quality, were sent by W. T. Falconer, J. VanDeusen & Sons, and M. E. Hastings.

Ohio.—The comb and extracted honey from this State was of fine appearance, also wax of very fine quality was shown. The largest display of implements, hives, etc., on the grounds was that made by A. I. Root.

Wisconsin.—The exhibit of comb and extracted honey from Wisconsin was not large nor particularly fine, but showed to the best advan-

tage in its tasteful arrangement. A six-comb self-reversing extractor of novel construction was shown by F. Williams. Springs throw the basket out when the speed of the machine is decreased, and turning in the opposite direction reverses them simultaneously.

In the foreign exhibits in apiculture there seemed to be nothing in the shape of new implements, hives, or methods of management indicated which American apiarists could adopt to advantage in their apiaries. But some of the educational features of the exhibit from Great Britain and Ireland were indeed worthy of the attention and, the writer believes, even of adoption, in the main, by apiarian societies here, particularly the examination and certification of experts of various grades, which the British Bee Keepers' Association practices. American bee-keepers, after a careful review of all that foreigners showed in apiculture at the Fair, could feel warranted in believing their methods in apiculture—the American system, which is distinctive—far in advance of all others. American manufacturers of apiarian supplies might also find suggestions as to additional markets for their products. And the magnificent piles of beautiful honey from the United States and Canada and the practical implements and hives shown with these exhibits must surely have served to give valuable information and increase the interest of many who are anxious to engage in the raising of bees, or, having begun, need to know in what way they can make further progress. To foreigners who were fortunate enough to see these exhibits, especially to the apiarists among them, it was a great revelation as to the actual advanced position of American apiculture.

THE SAN JOSÉ SCALE, AT CHARLOTTESVILLE, VA*.

By E. A. Schwarz.

SITUATION OF THE INFESTED ORCHARD.

The pear orchard of Dr. C. H. Hedges lies on a ridge just at the city limits of Charlottesville, about one-third mile from the center of the city and adjoining one of the main roads leading into the open country. While there are many gardens with various fruit trees between Dr. Hedges' place and the business part of the city, yet there is no other real orchard so close to the city excepting two old apple orchards situated at the base of the ridge and considerably distant from Dr. Hedges' place.

The infested orchard forms a square of about one acre in extent, and is, on the east side, separated from the street by an open grassy place about 25 steps across. On the north side it joins the lawn opposite and behind Dr. Hedges' house, where some old oak trees and vari-

* Report of investigations made under instructions from the Entomologist.

ous fruit trees are scattered about; on the west side it joins immediately the extensive vineyard of Dr. Hedges, which covers the slope of the ridge; finally, on the south side it is separated from the garden of Judge Reeves by two board fences and a narrow alley.

The orchard itself is planted with choice dwarf fruit trees, mostly pear, the trees being rather crowded, so that in many instances the branches interlock. On the northern side there is an open patch originally planted with currant bushes, but these having mostly died in the course of time are now replaced by strawberries. There are also a couple of small beds of various garden flowers, including a few rose bushes. Along the fence at the south side there are finally several rows of raspberry plants. The soil beneath and between the fruit trees is generally bare excepting numerous purslane plants growing on the less shaded places. Finally, there is a solitary fine Sweet gum tree (*Nyssa multiflora*) at the west side of the orchard.

THE INFESTED PLANTS.

The whole orchard, which was laid out eight years ago, may be said to be badly infested with *Aspidiotus perniciosus*, but by no means evenly so. To begin with the fruit trees, there were no scales whatever on the few quince trees and Japanese persimmon, though these stood in the immediate vicinity of other badly infested trees; there were a very few scattered scales on the young twigs of a few dwarf apples (Japanese) and plum trees (several varieties), a few more on peach trees. The pear trees form by far the greatest bulk of the orchard, and here a very striking difference between the varieties was noticeable at the first glance. The Lawrence pear trees, numerously represented in the orchard, were as a rule not at all infested, and only on a few trees isolated specimens were seen, usually on the fruit. In striking contrast to the Lawrence pear is the Duchesse d'Angoulême and derived varieties. Many trees of this variety are in all parts of the orchard, and every one of them is badly infested. The Bartlett pear and allied varieties are also uniformly infested, but decidedly less so than the Duchesse pears.

No trace of scales could be found on the Raspberry bushes, but most of the few remaining currant bushes were badly infested. Finally, scales were found on the few rosebushes in the orchard, but a single specimen of a rose with very rough and spiny surface (*Rosa rugosa?*) was perfectly free of them. All other plants, cultivated or wild, growing within the orchard, were absolutely free from the scales.

OTHER INFESTED PLACES.

Not a single scale could be found on the grapevines of Dr. Hedges' extended vineyard, although, as stated above, it immediately adjoins the infested pear orchard. Within this vineyard, and planted between

the trellis of the grapevines, is Dr. Hedges' second pear orchard. This is only about 200 feet distant from the infested orchard, but considerably lower than the latter, and proved to be absolutely free from scales. A careful examination was made of all trees (apple, peach, pear, oak, chestnut) on the lawn which joins the infested orchard on the north side, but no trace of the scale could be found here. Under the kind guidance of Dr. Hedges the orchards north and northeast of the infested place were visited and carefully examined. As a result it may safely be asserted that the Scale has not yet spread from the infested orchard in three directions, viz, north, east, and west. The only exception is formed by a little Purple Plum tree (not quite 3 feet high), which stands between the orchard and the main street (about 8 feet distant from the former), and which is badly infested. A Magnolia tree and a Weeping Elm close by are not infested.

Toward the south side, however, the insect was found to have spread into the adjoining garden belonging to Judge Reeves. This is a flower garden rather than an orchard, but contains various fruit trees, which are much older than those in Dr. Hedges' orchard. Scales in moderate number were found here on a peach tree, some pear trees (a sort of Bartlett pear), and on two rosebushes. There were none on the apple trees, nor could any be seen on other cultivated plants. Adjoining this garden further south is that belonging to Mr. Robertson, and here only a few specimens of the scale could be found on a single pear tree. Beyond this point the insect could not be traced further in any direction. The apple trees (all old trees) at the foot of the ridge south of this garden were examined without success, as well as many pear trees growing in gardens in the city, and more especially some gardens near the depot (2 miles from Dr. Hedges' place).

There can not be the slightest doubt that Dr. Hedges' orchard is the focus from which the Scale has spread somewhat in a southerly direction. There can not further be any doubt that the Scale is a recent importation, as is evident from the small area occupied by it, and further from the fact that the insect has not yet acquired that polyphagous habit which it possesses on the Pacific Coast.

Regarding the mode of importation nothing definite could be ascertained. Dr. Hedges has never bought any nursery stock or other plants from California; his oldest trees were purchased eight years ago from a New York nursery; other trees were bought three years ago from the Berckmans nurseries at Augusta, Ga., and about two years ago another lot of trees was obtained from a nursery at Crozet, Va. I suggested to Dr. Hedges that the trees from the latter source may have been infested, since the time when they were set out coincides with the time when the Scale was first noticed in the orchard; but he is positive that these trees were at first not infested and that the Scales were first noticed by him at another place in his orchard among his oldest pear trees, which stand near the old currant patch mentioned above. These

currant plants were purchased eight years ago from a New Jersey nursery. In the course of time Dr. Hedges noticed that the currant bushes were dying from the effects of what he believes to have been a Scale insect. Most of his bushes were therefore dug up, but this was long before the Scales were noticed on the pear trees. It appears to be highly improbable that the Scales were introduced on these currant bushes eight years ago because the whole orchard would no doubt have been infested long ago; and from the same reason the assumption that the Scale had been introduced with the original set of pear trees must be rejected. It is of course possible that the Scale came on the young trees bought at Augusta, Ga., or Crozet, Va., but this assumption can not be proven. At any rate it would appear that another mode of importation, viz, with California fruits, and more especially pears, is much more probable in this instance than the importation with nursery stock. Dr. Hedges informed me that in the fruit stores of Charlottesville California pears are sold just as in other Eastern cities, and the newsboy on the Richmond and Danville Railroad train told me that he had often California pears for sale. It is quite evident that specimens of this Scale are frequently brought with fruit, and more especially pears, from California to the Atlantic coast, although there is no record of this fact and it is generally denied.* It is equally evident that the chances of a permanent introduction of the Scale into the Atlantic States are very small; otherwise the insect would have made its appearance with us long ago and at many places. Nevertheless, its introduction in this way is by no means impossible, and in the Charlottesville case several combinations were exceptionally favorable to such introduction. Dr. Hedges' orchard, which contains many pear trees of just such varieties as are the favorite food of the Aspidiotus, is situated close to a much-frequented highway from which the rejected parts of a pear can be easily thrown into the orchard.

HABITS OF THE SCALE.

The habits of the Scale are presumably the same as they are in California, the most striking feature being its tendency to infest only the extremities of the tree. On most trees (excepting the Duchesse and Bartlett varieties) Scales are only on the fruit and on no other part of the tree but even in the worst affected varieties the top of the tree is much less infested than the lower branches. If the Scales are solitary on the pears the reddish ring which usually (not always) surrounds each individual Scale forms a very conspicuous object. The large diameter of the ring contrasts strongly with the small size of the Scale itself which usually occupies a small depression. This last is too shallow and indefinite to be seen but its existence becomes at once apparent if one attempts to remove the Scale with the finger.

*Scales are often found in the cavity of the calyx of the fruit where they can not be seen and from which place they can not be removed by brushing or rubbing.

Pears or branches thickly covered with the Scale occur only on the Bartlett and Duchesse d'Angoulême and derived varieties. Such pears usually show more or less extended longitudinal cracks, and, at the time of my visit, were dropping to the ground by the hundreds.

The appearance of the Scale on the twigs offers no special features; this year's growth is by far the worst infested, and there are only a few trees of which the older branches are infested.

The two varieties of pear trees just mentioned are the only plants where the Scales affect the leaves. Here either one or two or more quite regular rows of Scales are along the midrib (on both sides of the same), always on the upper surface of the leaf. On badly infested trees there are similar rows of Scales on the side ribs. It was noticed that among the Scales on the leaves there are proportionally many more male Scales than among those on other parts of the trees. The infested leaves do not appear to have the tendency to drop, but their color turns to a purplish brown.

The larvæ of the Aspidiotus were very abundant at the time of my visit, crawling about with great activity. Among those on the trees the tendency is noticeable to proceed to the extremities of the twigs, leaves, and fruit. Those crawling about on the ground among the fallen pears move considerably slower than those on the trees and certainly not in a definite direction. They are seen to ascend the few grasses, purslane, and other low plants that come in their way, while others are seen to descend again. The bright yellow color of the larvæ renders them easily visible, and even when still under the mother Scale they are so large as to be readily seen with the naked eye. There are usually only one or two young larvæ under one parent Scale, and since no eggs could be found under the many female Scales I examined it would appear that the species is viviparous, the larvæ hatching gradually. The appearance of many infested pears, which are densely and *evenly* covered with the Scales, further suggests that this gradual hatching of the larvæ has been going on uninterruptedly since several months, probably since the time when the fruits commenced to be formed; in other words, that there is in this species no succession of generations with definite intervals.

I failed to find or see a single male, but whether none existed during the time of my visit (August 17 and 18) or whether I overlooked them can not be decided.

ENEMIES.

Whether or not this colony of *Aspidiotus perniciosus* at Charlottesville is already infested by parasites was not ascertained during my visit. Several badly infested pears were carefully examined, but no exit holes of Chalcids were seen on the Scales. Only a few other species of insects were seen on the trees, of which only the following have any connection with the Scale: *Collops 4-maculatus* was present

in small number of specimens, but all being engaged in feeding upon the Aspidiotus larvæ. Whether or not they feed also upon the Scales themselves has not been ascertained. *Pentilia misella* (family *Coccinellidæ*) and its larvæ are very abundant on the infested trees and constitute an important enemy of the Scale. The imagos seem to prefer the full-grown female Scales, and the attitude they assume in attacking the same is quite peculiar. They stand astride over the Scale and elevate the posterior part of the body until they assume a nearly vertical position, being supported only by the head and the hind legs, which are extended to their full length. During this operation the head is pushed under the margin of the Scale. Thus practically standing upon their heads the beetles devour the contents of the Scale. The larvæ of the Pentilia were observed to feed on the Aspidiotus larvæ, and their mode of lifting up the Scales was not ascertained. No eggs of this useful little Coccinellid could be seen, and at first no pupæ were found until it was ascertained that the place of pupation is within the calyx of the pears. This cavity is always literally filled with a mixture of young and old Aspidiotus, full-grown Pentilia larvæ, their pupæ, and freshly issued imagos. But (as already observed by Mr. Hubbard) these Coccinellid beetles also serve as a means of transporting the Aspidiotus larvæ, and it is quite difficult to find one of these beetles which does not carry on its back at least one specimen. Sometimes three or four Aspidiotus larvæ may be seen on a single elytron of a Pentilia.

A small, black, shining ant (*Monomorium minutum*) is extremely abundant on the infested pears, evidently being attracted by the saccharine excretion exuded from the cracks of the fruits. It has no connection with the Scale, but almost every specimen carries on the back one or more specimens of the Aspidiotus larvæ. A few specimens of *Typophorus canellus*, red as well as black specimens, were on the pear trees, and here it was observed that on the red specimens no Aspidiotus larvæ were carried about, while on the black specimens such larvæ were seen. This preference of the Coccid larvæ for the shining black insects is also corroborated by other instances. A large red ant (*Formica schaufussi*) is also quite abundant on the infested pears, but does not carry about any Aspidiotus larvæ; none were seen on the backs of the Collops, and only in a few instances I saw a specimen on the back of the Pentilia larva, which is of a dull olive-brown color. There were also a number of Hyphantria larvæ on the pear trees, but no Aspidiotus larvæ could be seen on them, although the web of the single nest I saw had captured a large number of young Aspidiotus.

Finally, I would state that besides this Pentilia not a single other Coccinellid could be seen on the trees, and it appears to me that the complete absence of the common *Chilocorus bivulnerus*, which is by far the most effective enemy of Scale insects in Florida, is more especially a fact worth recording.

THE SAN JOSÉ SCALE IN VIRGINIA.*

By D. W. Coquillett.

In accordance with instructions I proceeded to Charlottesville, Va., on the 11th of December, and interviewed Dr. C. H. Hedges in reference to the presence of the so-called San José Scale (*Aspidiotus perniciosus*) in the orchards in the vicinity of Charlottesville.

A careful examination of the fruit and ornamental trees and shrubs on his place revealed the fact that as yet this pest was confined to the orchard of about 1¼ acres on the south side of his place, and to two peach and one Japanese plum trees near his barn, at a distance of about 150 yards north of the orchard above described. In Judge Reeves's garden, which adjoins Dr. Hedges's infested orchard on the south, are eight or ten pear trees and a few currant bushes infested with this Scale, while just south of this, in Judge Robertson's garden, are about a dozen pear trees likewise infested. These places are situated a short distance north of the city limits of Charlottesville, and I did not find a trace of the San Jose Scale in any other orchard or garden in and about Charlottesville. To the northward I examined the trees and plants for a distance of about three-fourths of a mile, or to the woodland; to the westward I examined them to a point beyond which no fruit trees were grown for a distance of about 1½ miles; to the southward I carried the examination through the city of Charlottesville and to a point about 1 mile beyond, also following the course of the city westward to its western limit; and to the eastward I examined the trees and plants to a point beyond which no fruit trees could be seen for a distance of several miles. Besides this, I also spent a day in examining the orchards located some little distance from Charlottesville, but found no trace of the San José Scale outside of the three gardens or orchards referred to above.

Of the trees and shrubs infested with this Scale, the Pear, Peach, Plum, Apple, Currant, and Rose were the most thickly infested, the Cherry less so, while the Quince, Gooseberry, and Raspberry were comparatively free. I did not find any of these Scales on grape-vines, strawberry plants, or weeds growing near the infested trees.

As to the source from which the San José Scale was first introduced into these three orchards, it is quite impossible to determine at this late day, but it appears very evident that it made its first appearance in Dr. Hedges' orchard. It has been suggested that the infection resulted from the use of infested pears, but Dr. Hedges informed me that he has never bought any pears grown in California, or in any other region liable to be infested with these Scales, and his neighbors assured me that they had never done so. The infested trees are located

* Report of investigations made under instructions from the Entomologist.

several yards from the public road, and it would be quite impossible for any passer-by to throw parings of fruit into the orchard while passing along the road. Nor does it seem probable that the infection came from the parings of infested fruit thrown out of the car windows by the passengers as they pass Dr. Hedges' place; the railroad is several hundred yards west of his infested orchard, while between them is a pear orchard of one hundred trees which is entirely free from this Scale.

The probabilities are that some of the trees in the infested orchard were infested with San José Scale when they were first obtained from the nursery. Dr. Hedges informed me that he first noticed the characteristic pink spots on some of his pears in the summer of 1892, and these grew on trees set out in November, 1884.

A few of the infested trees are about 14 feet high, but the majority of them are under 10 feet in height. About two hundred and thirty trees in all are infested.

PYRALIDINA OF THE DEATH VALLEY EXPEDITION.

In the report on the insects of the Death Valley Expedition, published in *North American Fauna* No. 7, pp. 235–268, we mentioned but five species of Pyralids and these belonged to the family Phycitidæ. A report on other material, however, has since been received from Prof. Fernald, from which we have drawn up the following short table, which may be considered as supplementary to the list already published. Prof. Fernald's descriptions of the new species follow:

Family PYRAUSTIDÆ.

Nomophila noctuella S. V	1 ex., Argus Mountains.
Pyrausta gracilalis Hulst	6 ex., Argus Mountains.
Pyrausta lethalis Grt	11 ex., Argus Mountains.
Loxostege anartalis Grt	1 ex., Argus Mountains.
Loxostege linealis Fern. n. sp	2 ex., Argus Mountains.
Loxostege flavalis Fern. n. sp	4 ex., Argus Mountains.
Loxostege oberthuralis Fern. n. sp	3 ex., Argus Mountains.
Loxostege napæalis Hulst	4 ex., Argus Mountains.
Prorasea simalis Grt	2 ex., Argus Mountains.
Titanio nuchalis Grt	3 ex., Argus Mountains.
	2 ex., Panamint Valley.
Titanio proximalis Fern. n. sp	2 ex., Death Valley.
	3 ex., San Bernardino Co.
	1 ex., Argus Mountains.
Gen. and sp? too poor for determination	1 ex., Death Valley.
Metasia quadristrigalis Fern. n. sp	2 ex., Argus Mountains.
Metasia argalis Fern. n. sp	1 ex., Argus Mountains.
Scoparia refugalis Hulst?	1 ex., Argus Mountains.

Family PYRALIDÆ.

Stericta trabalis Grt	3 ex., Argus Mountains.

Family PHYCITIDÆ.

Phycid, gen. and sp.?	1 ex., Argus Mountains. 1 ex. Death Valley.

Family CRAMBIDÆ.

Pseudoschœnobius opalescalis Hulst	1 ex., Argus Mountains.

DESCRIPTIONS OF PYRALIDÆ FROM THE DEATH VALLEY.

By C. H. FERNALD, *Amherst, Mass.*

Loxostege oberthuralis n. sp.

Expanse of wings, 32 mm. Head and palpi on the outside, bright reddish brown, white beneath; a white line running backward from over each eye. Thorax, pale yellowish, stained with reddish brown in front. Forewings, pale sulphur yellow, marked with reddish brown, as follows: A short stripe under the median vein at about the basal fourth of the wing and a smaller one in the middle of the cell. There is no indication of an inner cross-line, but the outer one starts from the outer fourth of the costa and gives off two small teeth outwardly, one inwardly nearly to the end of the subcostal vein, thence the line curves outwardly more than half way from the cell to the outer margin, and runs into vein 2, and after giving off a sharp outward tooth on the fold, is lost. The space between the cell and the outward curve is filled in with reddish brown, broken by two teeth of the ground color, extending inwardly from the outside, the upper and larger one extending nearly in to the middle of the end of the cell. Three geminate, wedge-shaped spots extend inward, one from the apex, and the others below it; and, below these, an ill defined band extends, parallel with the brown terminal line, to the anal angle. The fringes are pale reddish brown, divided by a darker line.

Hind wings, white, with a fuscous terminal line not reaching the anal angle within which the wing is stained by the same color; a faint trace of a cross line beyond the end of the cell. Under side of the wings and body, pale straw-yellow, the markings of the upper side of the forewings showing faintly beneath.

Described from one fresh specimen given me by Mons. Charles Oberthür, who obtained it from the late H. K. Morrison, collected in Arizona, and from a much-faded specimen in the National Museum, taken on the Argus Mountains, California, in April, 1891.

Loxostege flavalis n. sp.

Expanse of wings, 20 mm. Head, thorax, and forewings, light ocher yellow. Labial palpi, darker yellow on the outside, white beneath. The outer cross-line is represented by a row of more or less diffuse dark brown dots arising from a little beyond the middle of the hind margin, and curving outward slightly, then running up toward, but not reaching, the outer fifth of the costa. The inner cross-line is represented only by a dark brown dot on the basal third of the hind margin.

Hind wings, white, stained outwardly with very pale yellow. Under side of all the wings, very pale yellow. The cross-line of the fore wings, repeated beneath.

Described from two examples from the National Museum, taken in southern California.

Loxostege linealis n. sp.

Expanse of wings, 20 mm. Head, thorax, and palpi on the outside, light chestnut brown. Palpi, white beneath, and a white line over each eye, which extends forward and around the frontal projection.

Forewings, dark brown, chestnut brown on the basal part of the costa, and overlaid to a great extent with white scales, especially along the veins which are indicated by white lines. The inner cross-line is not indicated. The outer cross-line is white, nearly parallel with the outer border, and nearer to it than to the end of the cell, wider on the costa than elsewhere, and not quite reaching the hind margin. Terminal line, dark brown, bordered on the inside by a wider white line.

Fringes, pale yellowish, with a darker line through the basal part.

Hind wings, light ash gray, with a darker terminal line preceded by a light line, neither of which reaches the anal angle. The outer cross-line, which is scarcely visible, extends from the outer fourth of the costa nearly straight to a spot near the end of vein 2.

Fringes white, with an ash gray line near the base.

Under side of the fore wings, ash gray, lighter on the costa and beyond the cross-line, which shows faintly. Under side of hind wings silvery white, grayish along the costal portion; the beginning of a cross-line on the outer fourth of the costa. All the wings have a terminal row of dark points beneath; those of the hind wings do not reach the anal angle. Under side of the body and of the legs silvery white.

Described from one example in the National Museum, taken on the Argus Mountains, California, in April, 1891.

Titanio proximalis n. sp.

Expanse of wings, from 20 to 25 mm. Head, thorax, upper side of abdomen, and fore wings dark brown, overlaid more or less with whitish scales. The outer cross-line is represented by an ill-defined, dentate, dark brown line crossing the wing about halfway between the end of the cell and the outer border, and bent in below the cell. This line is margined imperfectly with cream white.

Hind wings, orange red, with a narrow, terminal, dark brown border.

Fringes of the same color as the border.

Under side of all the wings orange red, with brown fringes, and an oblique brown streak on the cross-vein.

A variety of this species has the hind wings orange yellow. It was taken on the Argus Mountains, California, April, 1891.

One example in my collection and two in the collection of the National Museum, collected in San Bernardino County, Cal.

This species is most nearly allied to *Titanio superba*, of Europe.

Metasia argalis n. sp.

Expanse of wings, 20 mm. Head, thorax, and fore wings straw yellow, sprinkled more or less with brownish scales. Labial palpi brown on the outside and white beneath.

The fore wings have the base, above the median vein out as far as the inner cross-line, thickly sprinkled with brown scales. The cross-line is oblique to the median vein, where it bends and runs nearly at right angles to the hind margin. The orbicular and reniform are strongly marked, and sprinkled within with brown scales; the former is slightly oblique; the latter straight on the inner side, and with a short, blunt outward tooth at the end of the subcostal vein. The outer cross-line starts from a point on the costa halfway between the reniform spot and the apex, and runs parallel to the outer margin, to a point between veins 5 and 6, giving off a single blunt tooth in the middle of its course, then, curving around beneath and touching the lower end of the reniform, continues obliquely inward and downward to a point below the orbicular on the fold, then runs to a point near the outer fourth of the hind margin, forming an inward angle on the fold and an outward angle on vein 1. The terminal space is sprinkled with brown scales quite densely along the inner edge, and especially below the cell, and is separated from the cross-line by a narrow clear

space. The terminal line is dark brown and broken. Fringes pale straw-yellow, mixed with brown scales.

Hind wings white, with a brown discal spot near the middle, and a brown cross-line extending from the outer third of the costa to a point beyond the end of the median vein, thence to the origin of vein 2, where it turns and runs to the margin within the anal angle. This line is obliterated at the beginning and on the median vein, elsewhere it is wavy in its course. The terminal space is sprinkled with brown atoms, leaving a clear space along the outside of the cross-line, widest behind the cell and towards the costa.

Fringes white, mixed with brown scales.

Under side of body and wings white, the latter showing the markings of the upper side more or less clearly; fore wings sprinkled with brown through the middle and in the terminal space. Legs white, the fore tibiæ brown on the outside.

Described from one specimen in the National Museum, taken on the Argus Mountains, California, April, 1891.

Metasia quadristrigalis n. sp.

Expanse of wings, 19 mm. Head, thorax, and upper side of fore wings yellowish brown, sprinkled with dark brown atoms, giving to these parts a dark, yellowish brown appearance. Palpi, darker on the outside than the head, and white beneath. Two white lines cross each fore wing. The inner line starts from the basal fourth of the costa, runs obliquely to the middle of the cell, where it turns at nearly a right angle and runs in a more or less zigzag course to the basal third of the hind margin. The outer line starts from the outer fourth of the costa, runs obliquely to a point nearly halfway between the end of the cell and the outer margin, thence runs to the outer fourth of the hind margin, curving slightly inward in its course. The reniform spot is very slightly indicated by a few dark brown scales on the end of the cell. The extreme edge of the outer half of the costa is marked with white and dark brown alternately. Fringes slightly darker than the surface of the wings.

Hind wings brownish, about as dark as the forewings, but without the yellowish tint, and with a row of faint dots along the outer edge. Under side of fore wings, grayish fuscous, whitish along the costa, and with four equidistant, dark brown spots on the outer half. The outer line is faintly indicated in dark brown, and there is a terminal row of dark dots. Under side of hind wings much lighter, coarsely sprinkled with brown, especially on the costal half, and a terminal row of brown dots and an outer curved cross-line starting from a brown spot on the outer third of the costa.

Described from one specimen in the National Museum, taken on the Argus Mountains, California, April, 1891.

ENTOMOLOGICAL MEMORANDA FOR 1893.

By Mary E. Murtfeldt, *Kirkwood, Mo.*

Disappearance of the Web-worm Tiger around St. Louis.—Among the insects which I, in vain, endeavored to collect during the past season was the valiant little Carabid *Plochionus timidus.* From dozens of Web-worm nests examined, both of the first and second broods, not a larva could be obtained. The result of the disappearance—temporary, it is to be hoped—of this important check on the development of *Hyphantria cunea* was noticeable in the unusual numbers of the second brood. I am at a loss to what to attribute the scarcity of the Carabid

unless to the excessive rains of the spring and early summer, which must have destroyed a large proportion of the insects that are habitually upon or beneath the surface of the earth.

The Rust-red Social Wasp an Enemy of the Web-worm.—While holding in my hands, for examination, a detached nest of *Hyphantria cunea*, in which the larvæ were about two-thirds grown, one of the above-named wasps alighted upon it and, tearing away a portion of the web, seized one of the worms between its feet, and driving its sting into the thoracic region, grasped the neck with its jaws and rose into the air, carrying its struggling victim with it. If I do not mistake, this wasp has not hitherto been included among the numerous species that prey upon the Web-worm.

Anthrenus varius on Blossoms of Viburnum.—I was much surprised to find, last spring, while noting the insects that were attracted to the corymbs of *Viburnum prunifolium*, that the small Dermestid above named was present in very large numbers, apparently outnumbering all other species combined. I have occasionally found the beetles of this group upon flowers, especially upon Spireas, but do not remember ever to have seen this particular species so abundant out of doors.

Scutigera forceps and Callimorpha.—The food of *Scutigera forceps* was the subject of some discussion among entomologists during the past year. As a contribution to the record of its habits, permit me to say that I found an unusually large specimen one evening in July devouring a *Callimorpha lecontei*, under the full blaze of a bright hall lamp. Coming downstairs, my eye was attracted by the singular appearance on the top of the newel post. A white moth was fluttering violently in what seemed to be some sort of indistinguishable web or haze. Having a cyanide bottle at hand, it was quickly placed over the mystery, and after the fumes had quieted all action the capture proved to be a specimen of the moth above mentioned, held fast in the jaws of the Myriopod, which had already eaten quite a hole in the side of the thorax. The mist-like observation had been produced by the incredibly swift motion of its numerous, long, slender legs while struggling with its prey. At another time I saw the same species feeding upon a specimen of *C. fulvicosta*, accompanying the action with the same rapid movement of its legs.

Trapping Codling-moth Larvæ.—Late last spring some of the deluge-like rains, which visited this section of the country, were followed by hard winds and in consequence of the saturation of the soil fruit and shade trees in large numbers were blown over. In our little orchard several large apple trees were prostrated and a number of others were with difficulty kept in position by means of braces of wood and guying with wires and ropes. To prevent these from cutting into the bark large pieces of bran sacking and old cotton cloths were used as padding in the forks and against the trunks. As very little fruit had set no spraying was attempted and the few apples that developed were

attacked by worms. Walking among the trees a few days ago I made an examination of the cloths and found them all webbed in every crease and fold with hibernating Codling-moth larvæ, hundreds of them, notwithstanding the scarcity of the apple crop. These will be destroyed before spring, and it seems to me that, after all, such methods of trapping are preferable to spraying in small private fruit gardens. The advocacy of the long disused hay or paper bands for the early broods of the worms should be renewed. Or, judging from my recent observation, a wad of old rags or sacking in the forks of the trees would perhaps be as efficacious as the band and somewhat less troublesome to arrange.

A NEW SPIDER PARASITE.

By William H. Ashmead.

The very interesting contributions of Mr. L. O. Howard toward a knowledge of the Hymenopterous parasites of North American Spiders, published in Insect Life, induce me to publish here the description of a new external parasite on a spider, discovered the past summer by Mr. Trevor Kincaid, of Olympia, Wash.

This species is of more than ordinary interest from the fact that three specimens were sent, while still in the larval state, attached externally to the spider, two of which transformed to imagos virtually under my eyes, and I am therefore able to describe the different stages.

My friend, Dr. George Marx, our highest authority on the Arachnida, has kindly determined the spider on which the parasite lives as *Tetragnathus* sp., it being in too shriveled a condition to be determined specifically.

The larva of the parasite, which is elongate-fusiform in shape, narrowest toward the head, and of a greenish-white color, lies extended longitudinally along the abdomen of the spider, the head being inserted close to the base of the cephalothorax, or where the abdomen is attached to the body. All the specimens received invariably occupied this position, and when they attain full growth almost completely cover the abdomen, the latter being visible only along the lateral margins.

This longitudinal position of the larva may be assumed for protective reasons, as in this condition it is less noticeable, appearing to be a part of the spider, or resembling a longitudinal white band, often observed in various spiders.

On reaching maturity the parasite leaves the spider and forms a web, loosely constructed, in the meshes of which it weaves a very characteristic cocoon, within which it passes its final stage to the imago. This cocoon is quite distinct from all other Ichneumonid or Pimplid cocoons known to me, and more nearly resembles those made

by certain Braconidæ, belonging to the genus Bracon, only very much narrower and not nearly so strong or tough.

This new spider parasite may be recognized from the following description:

Zaglyptus kincaidii, sp. n.

Larva.—Length, 1·6 mm. In outline fusiform, widest at penultimate segment and gradually tapering toward the anterior segment; width of penultimate segment, 0·6 mm.; width of anterior segment or head, about 0·2 mm.; mandibles small, piceous; color pale greenish-white or milky-white, the derma being finely but beautifully shagreened; ultimate segment with two large piceous-black spots at base laterally, posteriorly rounded with four very minute black tubercles; a series of lateral whitish spots above the spiracular region, those on the antepenultimate segment quite large. (Larva not fully matured.)

Cocoon.—Length, 7 mm.; greatest width at the middle, 1·6 mm.; elongate, tapering toward both ends almost equally, but tetragonal and composed of fine white silk closely woven into a parchment-like consistency.

Imago.—♀. Length, 4·5 mm.; ovipositor, 0·6 mm. Polished black, impunctate; mandibles, palpi, tegulæ, anterior and middle coxæ and trochanters, apex of middle and hind femora, basal two-thirds of middle tibiæ, broad band on hind tibiæ and basal half of basal joint of middle and hind tarsi white; apex of hind tibiæ black; rest of legs, except middle and hind tarsi, which are fuscous, reddish-yellow; fifth tarsal joint swollen.

Antennæ nearly as long as the body, black or brown-black, the apical edge of scape and pedicel pale. Mesonotum trilobed, the lobes convex; mesopleura with a femoral fovea posteriorly, polished; scutellum impressed at base, subtriangularly elevated posteriorly, smooth; metathorax longer than wide, delicately areolated, the pleura finely punctulate. Wings hyaline, strongly iridescent, the stigma and venation dark brown. Abdomen polished, much longer than the head and thorax united, with a short, reflexed ovipositor that is not longer than the first segment; segments 2 to 5 with a slight transverse impression and with a more or less distinct lateral impression; the concave venter whitish.

♂. Length, 4 mm. Differs from ♀ only in the usual sexual difference, and in having the scape and pedicel beneath wholly white, the flagellum black, the middle tarsi subfuscous, while the surface of the metathorax is finely rugulose and distinctly areolated.

HABITAT—Olympia, Wash.

Described from one ♂ and one ♀ specimen, bred from a spider, *Tetragnathus* sp., discovered by Mr. Trevor Kincaid, in honor of whom the species is named.

NOTES ON SCOLYTIDÆ AND THEIR FOOD-PLANTS.

By W. F. H. BLANDFORD, *Lecturer on Entomology in the Forestry School, Royal Indian Engineering College, London, England.*

For practical purposes the Scolytidæ may be divided according to their habits into four groups. Of these the first and most important is that to which the name Bark-beetles (*Borken-käfer*) properly applies; the females tunnel galleries in the inner bark or sap-wood of trees, from which the larvæ mine separate burrows, or more rarely clear away

patches of the surrounding tissues by advancing in an irregular column (e. g., *Dendroctonus micans*); the imagos when mature emerge through the bark by separate flight holes.

Of the one hundred and thirty or more European species at least one hundred and six are known or may be assumed to possess such habits.

In the Tomicini and Platypini we meet with divergences from the normal mode of life. The females of all Platypini whose habits are known, and of certain genera, Trypodendron, Xyleborus, etc., among the Tomicini bore deeply into wood, in the recesses of which the larvæ develop. In Trypodendron the larval galleries persist as short blind chambers, indicating that this mode of life is an adaptation from the primitive subcortical habit.

The Xylebori have gone a step farther, their larvæ having as a rule abandoned the construction of galleries for themselves, and lying in and feeding on the contents of the mother burrows. They are further distinguished by the stunted and flightless condition of the males, which are rarer than the females, a feature not found in the less specialized Trypodendra.

The larvæ of *X. cœlatus* Eichh., are subcortical miners, but the published figures of the insect, and the description given by Eichhoff, Le Conte, and others indicate, as do its habits, that it should be referred to the genus Tomicus, where Eichhoff has placed it. The wood-boring habit is correlated with a different structure of the maxillæ, which are fringed with hairs instead of the flat spines found in phlœophagous species, and the two modes of life, associated as they are with structural differences, are unlikely to occur in the same genus. The generic names of American Scolytids are by no means in accordance with those used by European coleopterists who have investigated the structure of the mouth-parts, a point which widely separates the species of Gnathotrichus (*materiarius*, *retusus*, etc.) from the bark-feeding Pityophthori, with which they were associated by Le Conte. Fourteen European Scolytids are wood-borers, but in tropical countries the proportion of wood-borers to bark-feeders is much greater, and perhaps the former preponderate.

A third habit, characteristic of certain Cryphali and Cryphalus-like forms (usually bark-feeders) and of Coccotrypes is that of burrowing, in the manner of Anobiids into seeds, roots, and other hard substances, such as book-bindings. Examples are to be found in *Cryphalus jalappæ* and *Hypothenemus eruditus*. No European species live in this way except such as have been imported from time to time in their food materials.

Lastly, a few Tomicini attack the softer chlorophyll-containing tissues, usually the stems, of herbaceous plants. This class of injuries is a modification of either of the three preceding life habits, and is of some interest. As yet little is known about it.

In Europe the genus Thamnurgus breeds in the stems of various species of Euphorbia, of Delphinium, Origanum and Teucrium, and according to Perris, the females do not burrow, but lay their eggs in wounds gnawed on the outside of the stem; in this genus the asperities on the front of the prothorax have completely dissapeared.

In Burma a species which I have identified as *Platydactylus sex-spinosus* Motsch (Ind. Mus. Notes, III, 1, 64), injures rice by boring into the stalks, and has been known to destroy a field of an acre (*loc. cit.* I, 1, 61). This attack on the thin stem of a cereal, a very different thing from that of *Xyleborus perforans* on the woody sugar-cane, is so remarkable, and the insect, common in collections from Ceylon and the Malay Archipelago, is of so singular a form, that it is to be regretted that no further information has come to hand. The mode of larval life is unknown, and it is impossible to conjecture whether the larva is destructive or whether the beetle alone is responsible for the damage and breeds in other material, as is the case with *Myelophilus piniperda* and its attacks on pine shoots.

Two undescribed instances of depredations on soft tissues have come under my notice.

In the early part of this year I received from Mr. C. A. Barber superintendent of the botanical department of the Leeward Islands through Mr. T. D. A. Cockerell, specimens of a small Tomicine which had injured the young leaves of sugar-cane in Nevis, West Indies.

Three beetles alone were sent, belonging to two species, and no specimens of the injured leaves.

A demand for more material brought specimens of the leaves with beetle-holes and burrows, and of the insects preserved in alcohol.

The offender is *Hypothenemus eruditus* Westw. The examples show certain differences from the type, but not of sufficient importance to indicate a new species. The diversity of color is strongly marked, the posterior part of the head, the prothorax, and limbs being testaceous the rest piceous; the prothorax is more convex, the disk less depressed on either side, its asperities few, very large, and piceous at the tip, the anterior border with but four or five well-marked tubercles; the length averages 1·4 mm. The color and sparse tuberculation of the thorax give it a very different appearance to the unicolorous *Hypothenemus aspericollis* Woll, from the Canaries, which Dr. Sharp regards as the same species, and in which the thoracic tubercles are numerous and smaller. But I agree with the latter and other zoologists as to its variability, and it appears desirable that these separate forms should not be regarded as specifically distinct unless they coexist in the same country.

Two structural points deserve notice.

There is some doubt as to the number of joints in the antennal funiculus of *H. eruditus.* Westwood describes and figures three, indicating one suture in the distal division. Eichhoff, while admitting its possibility

identity with *Stephanoderes arecæ*, Hornung (since confirmed by Fauvel), points out that the number of joints in the funiculus required by his genus Stephanoderes is five. According to Le Conte *H. hispidulus*, perhaps a form of *H. eruditus*, has but one division in the outer part of the funiculus, which agrees with Westwood's statement. In a Nevis specimen I have found two divisions, so that the funiculus is four-jointed. It is probable, as Le Conte points out, that the number of joints is of no value as a generic character for Hypothenemus; but it will be remarkable if it is found to vary within the limits of a single species.

The other point concerns the position of the head with regard to the prothorax. Le Conte hesitates to identify two American Hypothenemi with species of Stephanoderes described by Eichhoff on account of the head not being retracted into the prothorax as required by the description of the latter genus. But this, whether good or bad, depends on other characters than the position of the head, which merely serves as a point of departure between those Tomicini, such as Aphanarthrum, in which a rostellum is present, and the majority in which it is absent. The position of the head depends very much on the way the specimens are killed and mounted; it is prominent in those preserved in alchohol. Schwarz (Bull. Brook. Ent. Soc., VII, p. 84,) says of *H. eruditus:* "Not rarely specimens occur in which the head is protruded and thus apparently not covered by the prothorax. Upon such specimens Mr. Eichhoff seems to have established his genus Stephanoderes." This is a misunderstanding, and indeed a reversal of Eichhoff's position.

H. eruditus attacks the youngest cane-leaves while they are still rolled in a spike, perforating them transversely, so that the leaves when unrolled show a series of holes which form parts of a single burrow. Two or three specimens exhibit nothing but these transverse burrows. In two others a rib has been reached, and its contents excavated so as to form an irregular chamber, in one case five-eighths of an inch, in the other 1 inch long. The chambers contained one or two beetles and several nearly full-grown larvæ, which lay in the main excavation like those of Xylebori and did not construct separate burrows. They may however have enlarged the cavity, the walls of which were irregular and ragged. There were no holes communicating with the outside except the entrance hole, nor any sign of the immature beetles having tunneled the leaf-tissues.

The attacked leaves showed no signs of injury beyond that due to the beetles, they were not dry or shriveled, and I do not doubt that Mr. Barber would have noticed any abnormal condition preceding the attack. Round the holes the tissues are brown and discolored, particularly near the brood-chambers, which hollow out the ribs so as to seriously interfere with, if not to destroy, the nutrition of the parts beyond the point of attack.

No details have been sent about the circumstances of this infestation which would enable proper treatment to be suggested. It is pos-

sible that a *weak* arsenical spray applied to the leaf-shoots will ward it off.

This tendency of *H. eruditus* to attack young unopened leaves is noticeable, as it has hitherto been found in dry substances, betel, book-bindings, the dead twigs of orange and vine, according to Hubbard (Ins. Orange, p. 173) sedulously avoiding any part of the tree so long as it retains its sap or remains moist.

The other species to which I have referred I received from a gentleman who informed me that it had been very destructive to some newly imported Dendrobiums in his orchid-house. It attacked the bulbs, aerial roots, and stems, from which I extracted several females, one male, and larvæ. The parts injured were about one-sixth of an inch in diameter, and were channeled out by longitudinal burrows. The nurseryman who imported the Orchids has informed me that the species in question came from New Guinea. I have reason to believe, though he has not informed me himself of the fact, that the insect has been destructive in his houses, and I can not feel sure that it has been confined to its native species. Under the circumstances I can not be sure of its original locality. It is closely allied to *X. curtulus* Eichh., from which I could not separate it by description, but recently I have examined the type of the latter insect, which obviously differs in points not brought out in the description. The only other species of close resemblance to these two *Xylebori* is *X. compactus* from Japan. They form a somewhat distinct group.

Xyleborus morigerus n. sp.

Brevis, compacta, cylindrica, nitida, ferruginea elytris nonnunquam utrinque plagâ discoidali piceâ, parce pilosa, thorace subgloboso, antice rugis transversis exasperato, margine apicali tuberculato, postice lævi, parce punctato, supra scutellum plaga pilosa ornato; elytris valde convexis versus apicem rotundatis-declivibus, subtilissime lineato-punctatis, interstitiis in declivitate pilis uniseriatis setulosis.*

Long. 1·8^{mm}.

Mas. Minutissimus, depressus, pallide testaceus, longe pilosus, thorace lateribus valde rotundatis, angulis posticis obtusis, antice tuberculato, postice subtilissime punctato; elytris ovalibus, depressis, fortiter ac irregulariter punctatis.

Long. vix 1^{mm}.

Hab. incert.; in caulibus orchidum ex Nova Guinea invectarum habitans.

Bright ferruginous brown, in most specimens with a well-marked blackish, discoidal patch on each elytron. Head finely alutaceous, with very short pubescence, eyes deeply emarginate. Thorax transverse, slightly narrowed at base, base bisinuate, its angles obtuse, sides and apex strongly rounded, apical margin with six or seven tubercles; disk convex, not gibbous, anterior half pubescent and with concentric rows of asperities, posterior half smooth shining, with scattered fine punctures, and a median patch of pubescence above scutellum, which is small, cordate, and smooth. Elytra as wide as thorax at base and half as long again, sides straight to near apex, then abruptly and strongly rounded, very convex to middle, which is elevated, thence strongly declivous to apex; finely punctured in lines, punctures shallow, interstices flat, with a single row of punctures as numerous but finer than those of striæ, glabrous to middle, thence bearing a single row of longish hairs.

* It seems logical to me to describe *Xylebori* which is always done from the ♀ in the feminine; if the usual manner is preferred, the genders can easily be changed.

Male.—Very small, flattened, oval, testaceous yellow, with long sparse yellowish pubescence. Head alutaceous, impunctate except over mouth, eyes oblong oval, black, entire. Thorax broader than long, widest just before base, narrowed to apex, sides from widest part and apex uniformly rounded, basal angles broadly rounded, base bisinuate, disc but slightly convex, flattened in middle, anteriorly with faint traces of asperation, posteriorly with very fine scattered punctuation covered with scattered pubescence. Elytra narrower at base than thorax, and half as long again, slightly dilated behind middle, numeral angles obsolete, rounded, sides elliptically rounded to apex; disk declivous from middle to apex. The angle of the declivity rounded, with strong scattered punctuation, the interstices slightly rugose, striae entirely obsolete, sutural margin raised posteriorly, legs long, anterior tibiæ slightly dilated at apex with two almost obsolete spines on outer margin. Length 1 mm.

As compared with *X. curtulus* this species is larger, especially broader, and more brightly colored; the hairs at the base of the thorax are shorter and less conspicuous, the elytra are shorter in proportion to the thorax, more finely punctured, and the interstices are not pubescent before the middle, whereas in *X. curtulus* they are pubescent for their whole length.

The peculiar circumstances under which this insect has depredated render it easy to get rid of by the timely sacrifice of the attacked parts of the orchids. This has had to be freely carried out by the sender of the specimens.

The few examples I have here recorded of Scolytid injury to the soft parts of plants agree in the damage being confined to the stem or the fibrovascular parts. Damage to the parenchyma of leaves, except by the burrows made by *H. eruditus* to reach the ribs, is as yet unknown.

EXTRACTS FROM CORRESPONDENCE.

Syrian Book-worms.

I send with this a live book-worm, which I found last week in an old manuscript which I recently brought from Syria. A careful search through the numerous Arabic and Syrian manuscripts in my possession might perhaps reveal others, though I have tried to get rid of them, and once in Sidon found three specimens in a single book.

I also inclose a clipping from the *New York Sun* of the 31st ultimo. Trusting to my memory I would say that the figure "Mr. R. Hooke's Bookworm" represents an insect very common in Syria, and there called *smer-keh*. The houses, especially in closets, behind pictures hanging on the walls, etc., swarm with them. They are troublesome in libraries, but generally, if not always, begin their attacks from the outside. They eat the covers of the paper-bound books and the outer leaves of unbound books and loose papers. They may eat through a few leaves, but never burrow through a great number in the style of the worm which I inclose. I have also seen cloth-bound books which they were accused of having defaced—with how much truth I can not say from my own experience—and which, while none of the cloth was eaten, looked as though the creatures had a great fondness for the coloring matter or the sizing of the binding. I found that my library was perfectly protected against the *smer-keh* by first freeing the books and cases of all specimens and then standing the cases a short distance, say half an inch, from the wall. The insects get into the bookcases and wardrobes from the walls and not from the floors. * * *—[William S. Watson, New Jersey, August 30, 1892.

Reply.— * * * The insect proves to be a Tineid larva not represented in the collection of the National Museum. Your account of your experience with it in Syria is an interesting one. While knowing nothing of the habits of the insect in question other than what you have told me, I should say that the remedy ordinarily used against book mites, namely, the abundant application of pyrethrum powder, would avail against it. Most book mites and pests affecting libraries and records are chiefly injurious in moist situations, and, if care be taken in the matter of dryness in libraries and on bookshelves, the danger is much lessened.—[September 2, 1892.]

The Cheese Skipper Injuring Hams.

There was an interesting article in last Insect Life on "The cheese or meat skippers," but the author does not state whether the young skippers are able to penetrate the bags in which hams are put; if they can, there is no use in taking the trouble to bag them.

We smoke the bacon almost a month with hickory chip fires, occasionally using sulphur; about March 1 we bag them, rubbing them over with black pepper before putting in bags. If after hot weather comes on we find any skippers, we sun them, which brings the skipper to the surface and kills them. We smoke occasionally with sulphur during the summer on still damp days. But with all this care we find some hams injured, especially if mice have cut holes in bags and meat.

Skippers do not attack shoulders or middlings to any extent; we do not bag these. If they only attack smoked meat had we not better omit smoking, the value of which is doubtful?

I think that Cincinnati ham-curers dip their hams in pyroligneous acid.—[A. G. Grinnan, Virginia, December 25, 1893.

Vegetarian Mosquitoes.

I have just read a notice by A. A. Eaton, of California, concerning vegetarian mosquitoes. I have often seen mosquitoes feeding on vegetable substances here. The first I particularly remember was about fifteen years ago, when I noticed that the rinds of some watermelons that had just been removed from the table were thickly covered with mosquitoes, evidently highly enjoying their desert. Since then I have frequently seen mosquitoes on cut fruit, though I do not think I ever saw them puncture the rind.—[Frances M. Slack, Massachusetts, October 13, 1893.

A Cat Warble.

I write to inquire concerning an insect the larva of which is parasitic on cats. I have only observed one case, the description of which is as follows: The larva is oval in shape, about an inch or seven-tenths of an inch long, and at least three-tenths of an inch thick. The color would be white, but the insect is covered with small black excrescences, and so appears brownish black. It burrows under (or perhaps the egg is laid under) the skin, in exactly the same manner as the larva of the common "gad-fly" does on cattle. In the one case I have seen, the location of the insect was on the belly of the cat, but I have been told of a case where the larva was in the eye-lid. I have also been told that what appears to be the same insect is often noted as parasitic on the gray squirrel—[Barry C. Hawkins, North Carolina, September 8, 1893.

Reply.—I have never heard of a subcutaneous bot in the domestic cat before, and without seeing the larva or the fly can not determine the species. It is likely that it may be the same species which commonly affects squirrels and gophers throughout this country, viz, *Cuterebra emasculator* Fitch, an account of which you will find in Insect Life, Vol. I, p. 214, a copy of which is sent you by accompanying mail. It may, however, be the Rabbit Bot (*Cuterebra cuniculi*), or still another species. The facts which you give are very interesting, and if you can secure specimens of this larva it will give us great pleasure to examine it.—[September 13, 1893.]

The Blood-sucking Cone-nose again

Inclosed you will find an insect that I would like to know something about. It was found under the following circumstances: About 1:15 a. m., August 16, 1893, I was aroused from my sleep by my wife's heavy breathing. On questioning her, she complained of severe headache and a sensation of swelling about the face, which rapidly spread to all parts of the body, and the itching becoming unbearable, sickness at the stomach and vomiting followed; the body and limbs broke out with red blotches, welts, or eruptions, like a severe case of measles. By bathing her freely with sweet oil she went to sleep in about fifteen minutes, and all signs of the poison disappeared except the pallid expression of the face and a slight swelling on on the shoulder, where the wound was inflicted by the bite or sting. When I first awoke I made a search for insects and found this one on her pillow. Two years ago she nearly died with the same symptoms, and the next morning two large insects, the same as this, were found on the bed, and, when killed, were found to be full of blood. I therefore suspect this fellow of being somewhat dangerous. If you can tell us whether we can attribute the sickness to this insect, you will do us a favor.—[J. L. Hathaway, Arizona, to Prof. J. W. Toumey, August 16, 1893.

REPLY to Prof. Toumey: The Conorhinus which you send has been carefully examined. It is probably one of the Mexican species of this genus, but is in too poor condition for specific determination. It differs, however, from any of the named species in the national collection. All of the species of this genus have the blood-sucking habit, and you are doubtless familiar with the accounts of *C. sanguisuga.* I see no reason to doubt the accuracy of Prof. Hathaway's account, supposing that his wife is peculiarly susceptible to disturbances of the system from insect bites. You will find in the annual report of the Entomologist for 1884, p. 414, an account by Prof. J. G. Lemmon, of California, of an experience which he and his wife had with a species of this genus, which reminds me of Prof. Hathaway's account. Prof. Lemmon's experience was in the Santa Catalina mountains of your State.—[September 14, 1893.]

Leaf-hopper Damage to Winter Grain.

I send you to-day by mail samples of flies or insects which are infesting the small grain fields in this part of the county, and which in some instances completely destroy the oats and rye. The insect appears in great numbers, and when the oats and rye are just up completely destroys them; after the grain gets good root and begins to spread out they do not kill it out so badly, but keep it from growing, and it looks sickly and small. What is the name of the insect and how can we get rid of it? In young rye planted for grass they are now in great numbers—millions—notwithstanding we have had several good frosts. I have been in several counties lately and see them everywhere, but not so numerous as on my place. In some places they have damaged the young turnips.—[L. S. Connor, South Carolina, November 20, 1893.]

REPLY.—The insects which are damaging your small grain belong to two or three different species of Leaf-hoppers, including *Diedrocephalus flavipes* Riley and *Cicadula 4-punctata* Fab. Injury of this kind is comparatively rare; but two or three cases are on record. In his annual report as entomologist of this Department for 1879, Prof. Comstock treated of the damage done by a closely allied species, *Cicadula exitiosa,* to winter wheat in your own State. You will find a full account of this occurrence in the annual report of this Department for 1879 (pp. 191–193). The damage was done during the winter of 1879–'80, and was attributed to the extremely mild season. Similar damage to wheat has occasionally been reported in parts of Europe, and in the spring of 1875 such injury was reported from certain parts of Illinois; also during the winter of 1876 from parts of Texas. Under ordinary circumstances leaf-hoppers are kept within winter quarters and many are killed by the cold weather. The only remedy which was recommended in this report was the carry-

ing of lighted torches through the fields at night and the building of bonfires at different points, with the view of attracting the leaf-hoppers to death in the flames. The *Diedrocephalus flavipes* which you send in was first described by Prof. Riley in The American Entomologist (Vol. III, p. 78). This is the species which damaged wheat fields in Texas, as above mentioned, in 1876. No remedial measures are given in connection with the description.—[December 19, 1893.]

The Egyptian Icerya in Australia.

You will be interested to hear that a short time ago Mr. W. W. Froggatt, of Sydney, sent me a number of Coccids, amongst which was one which I can not identify as anything else than *Icerya ægyptiaca* Douglas. The characteristic curling waxy processes were present; the antennæ agree exactly with the figures of Douglas and INSECT LIFE; the feet agree; the hairs and spinnereta of the body agree; and the color of the insect agrees (although to my eyes it is rather "red" than "orange"; but that is unimportant). The only discrepancy is that Douglas gives the length as one-fifth inch; my specimens are rather more than one-tenth inch; yet they are adult, having antennæ of eleven joints, but *early* adults not having formed ovisacs. I do not attach them to *I. montserratensis*, as the last antennal joint is *shorter* than the three preceding.

Among the specimens were some of the second stage ♀, with 9-jointed antennæ. Neither you nor Douglas described this.

It was my impression that perhaps these insects had been brought from Egypt to Australia in plants or flowers by steamer passengers who might have staid at Cairo or Alexandria. But on asking Mr. Froggatt to get me some more, he says in reply: "I will try to get out to where I found them, but it is a rather awkward place unless one makes a special trip for it; it is rather a settled district with old orchards within a mile or so; but they were quite in the bush and pretty plentiful." This seems to point to an indigenous habitat. May this also perhaps be an Australian Icerya?

I venture to send you this note as I see *I. ægyptiaca* has been found in India. It will be important to recollect that there is a rather large trade in horses from Australia to India, and the insect could readily have been carried in the numerous steamers plying in it.—[W. M. Maskell, New Zealand, October 22, 1893.

Damage by Locusts in Colorado.

* * * Locusts have caused hundreds of thousands of dollars of destruction; mostly in alfalfa and potatoes, and injuring wheat, oats, and barley, and orchards. They roosted in all varieties of trees to some extent, but, having abundance of the two first named plants to eat, they fed mostly on them; but to some extent they are omnivorous. They ate the leaves of apples (leaving the main rib) and girdled the limbs of plums, and in some cases the bodies of three-year olds, and cut off the leaves during the night and cloudy cool days.

Hopper dozers were used, and bran and Paris green, but these devices proved of little use, as the hatching in numbers was nearly continuous until late in September, and at this date there are quite young ones mixed with old ones. There has been also, every variety ever seen or heard of in color and size.—[E. H. Benton, Colorado, October 3, 1893.

Concerning Spider-egg Parasites.

Argiope argentata, the most beautiful of the many species of Argiope here, is very common on the Island of Catalina and the coast ranges on the mainland.

Its cocoons may be found in abundance on the common *Opuntia engelmanni*, in the months of August and September, and in examining them I found a large number of them parasitized. Of those gathered on the Island over 60 per cent were affected

with *Eupelmus piceus* Riley, and *Sarcophaga davidsonii*, Coq. Of those collected at Redondo no less than 95 per cent were parasitized—20 per cent with Sarcophaga and the remainder with Eupelmus.

I failed to collect at such an early stage as to ascertain whether the parasite deposits its eggs in those of the spider, or only among them; but of this I am sure, after hatching they eat every egg they come in contact with, and if very numerous eat yolk, membrane, and all. I kept those till they hatched and found the average time of pupation was fifteen days; some, however, have remained in the larval stage for more than a month, and may possibly remain so all winter.

The number of Eupelmi contained in some of the cocoons seems unusual; of seventeen taken at random and counted one contained one hundred and eight and the total average was sixty-six.

Of the Sarcophagæ a few hatched after ten days in the pupa stage; the others are either dead or awaiting the spring. The average number of Sarcophagæ in each cocoon was three, but many of these proved abortive, as they in their turn were affected by a species of Tetrastichus, the cocoons being literally packed full of these little insects. I counted the contents of two of them; they numbered fifty-six.

Sarcophaga davidsonii I have also found in the cocoons of *Phydippus opifex,* as has already been reported by Prof. Coquillett in INSECT LIFE, and this season, though this spider is more abundant than heretofore, yet I find not more than 10 per cent of them affected and none with epiparasites.—[Anstruther Davidson, M. D., California, October 3, 1893.

Abundance of the Red Spider in Illinois.

Since this terrible drought, which more severely affected a certain section, including this vicinity, I have noticed trees and shrubs, during hot winds from the southwest, with leaves suddenly turning as if burnt and falling off. Often alternate trees in a row are so affected. Sometimes the damage commences just above the lower clump of trees, goes right through upwards, and leaves the tree green below and above, especially northeast below and southwest above, but always beginning southwest. Today I observed a row of Sweet Pea vines similarly affected, regardless of constant watering, and soon I saw them covered with webs. I at once made my rounds, and found Cherry, Apple, Rose, Peach, Pear, Trumpet Creeper, Prickly Ash, etc., more or less affected in my own garden, and vegetation everywhere affected similarly. I give this as a sample and inclose affected leaves of *Zanthoxylum fraxinium*, Cherry and Sweet Pea vines. The webs on *Z. fraxinium* (Prickly Ash) are most severe, as stems from the ground to the tip are coated. The Sweet Pea comes next, being affected from the ground up, but the tops of these trees are still green and in bloom. The Cherries, etc., are differently affected, some more and some less, the webs being mostly on the under side of the leaves and thickest toward the wind, where the dust is filling the web and the latter is probably doubled over by the insect on that account. I also observed a large Apple tree with Trumpet Creeper running upwards on the southwest or windy side, literally covered with this fine web between the creeper, the leaves of which are still green. A large Elm near by, also with a creeper upon it, is free from the webs, but the leaves of the creeper are somewhat affected. I notice that the little spider on Prickly Ash seems longer (more oval) and lighter in color than that on Cherry, the latter being more round and darker, resembling the spider, often injurious to house plants in hot, dry, sunny rooms. In the hurry and short time of observation I noticed but one parasite which was seemingly feeding upon the spider. This was the larva of a Lace-wing Fly.—[A. H. Mundt, Illinois, September 5, 1893.

REPLY.—The leaves which you send are affected by a Red Spider of the genus Tetranychus, allied to but differing from the common Red Spider of the greenhouse (*Tetranychus telarius*). Its occurrence in your vicinity in such numbers is somewhat

unusual, although similar instances have been brought to the attention of the Division before. This mite is readily amenable to the kerosene emulsion, particularly when a small quantity of flowers of sulphur has been added.—[September 11, 1893.]

Kerosene and Animal Parasites.

I tried a little experiment during last August with our ordinary coal oil. I saw a number of my hogs were not doing well. They were continually rubbing against the fence or some post. I put one gallon of oil into my knapsack sprayer, put it on my shoulders and walked out to the pen. I could not get my hogs quiet enough to spray well, so I put some corn chop into their box, and while they were eating I gave them an excellent covering of oil, very finely put on by said sprayer. My neighbors said "The hair will come off"—others said, "It will blister." I awaited my result. Next morning on examining their backs I found great loose scales of dirt and mange, and under these and among them were thousands of dead lice. Result—my hogs are smooth and slick, lice all gone. Have tried same in hen houses to kill chicken mites, also lice on horses. A flannel cloth saturated with best coal oil and rubbed over eggs from Bot Fly on horses' legs causes eggs to loosen and drop in a short time.—[E. H. Kern, Kansas, December 30, 1893.

NOTES FROM CORRESPONDENTS.

Larvæ in a Child's Face.—A correspondent from Fort Collins, Colo., mentions a peculiar case of a child 15 days old affected with a subcutaneous larva on the right side of the face, neck, right arm, and hand. The "worms" were inclosed in indurated sacks. Thirty-two were removed and in one case four from one sack. They are described as being about 3 lines long by 1 line wide. They were segmented or ringed, white in color with light brown head, and sparsely covered with microscopic hairs.

Larval Food of Euxesta notata.—Prof. J. B. Smith recently wrote us that he had reared this Ortalid fly from Onions and asked us whether we had ever published anything concerning its larval habits, since he had noticed in a foot note to the description of this species in Vol. III of the Smithsonian Monographs of Diptera, a statement by Baron Osten Sacken that he had received specimens from us reared from larvæ in the pulp of Osage orange. Examination of our notes shows that we have reared the fly from cotton bolls from Alabama, from Sumach fruit from Virginia, from bolls of *Solanum carolinense* in the District of Columbia, from Osage oranges in Missouri, and that Mr. Coquillett has reared it from Apple previously infested by Codling Moth in California.

Change of Address.—Prof. A. J. Cook, for many years professor of entomology in the Agricultural College of Michigan, has removed to Claremont, Cal., where he is professor of zoology in Pomona College.

Abundance of the Purslane Caterpillar.—Mr. T. J. Brewster, of Lucerne, Kans., writes us that the Purslane Caterpillar was extremely abundant in his vicinity during the summer of 1893. He considers this insect a positive benefit to the farmer since it rids the land of such an obnoxious weed.

Road-dust Against Swine Lice.—Noticing on p. 165 of the last number of INSECT LIFE that road-dust is recommended by Prof. Osborn as a remedy against lice, Mr. T. J. Brewster, of Kansas, writes that the lousiest hogs he ever saw were confined in extremely dusty pens. He finds kerosene emulsion one of the most effective and cheapest of remedies.

A new Food-habit of a Clothes Moth.—We have lately received from Dr. J. C. Merrill, U. S. Army, now stationed in Washington, D. C., a can of beef meal rejected

as being "weevily." The damage was due to the presence of the larvæ of our commonest Clothes-moth, *Tinea biseliella*. This is a new but not unexpected food for this species.

A Plague of Locusts.—Mr. Erwin L. Horton reports a plague of locusts in Schuyler County, N. Y., during the past summer. He believes the species to have been the Red-legged Locust (*M. femur-rubrum*). Many of them were infested by the red mite (*Trombidium locustarum*).

GENERAL NOTES.

RECENT ENTOMOLOGICAL PUBLICATIONS OF THE U. S. NATIONAL MUSEUM.

During October and November, 1893, there were published by the U. S. National Museum three important entomological bulletins, and separates of two other entomological papers from the Proceedings.

The first to appear was Bulletin No. 44, "A Catalogue, Bibliographical and Synonymical, of the species of Moths of the Lepidopterous Superfamily Noctuidæ, found in Boreal America, with critical Notes," by John B. Smith. This is an elaborate and very useful catalogue, covering 425 pages. It is not only bibliographical and synonymical, as stated in the title, but gives the exact geographical distribution of each species and indicates the place where the type is to be found. Useful comments by the author frequently follow under the head of each species, as also an index to the authors and works cited and a general index to species and genera.

The second of the three publications is Bulletin No. 45, "Monograph of the North American Proctotrypidæ," by William H. Ashmead. This is an elaborate publication, upon which Mr. Ashmead has been working industriously for a number of years. It comprises full descriptions of all the North American forms known to him, the very great majority of which are either in the collection of the National Museum or in Mr. Ashmead's private collection. Almost the only exceptions are a few species in the Berlin Museum. The volume covers about 470 pages and is illustrated by 18 plates, upon which are figured representatives of 143 genera, one plate being devoted to details of structure. The introduction to the Monograph comprises a consideration of the external structural characters of the group, the habits of the perfect insects, an account of their transformations and life history, and their distribution, together with a running history of the previous attempts at classification. Careful tables of subfamilies and genera, as well as of species, are given. The publication of this Monograph gives American students an excellent start in an important group which has hitherto been almost entirely neglected.

The third paper forms Bulletin No. 46, and is entitled "The Myriapoda of North America," by Charles Harvey Bollman, edited by L. M.

Underwood, and contains the collected writings on North American Myriapoda, both published and unpublished, of the late C. H. Bollman. There is an introduction, with a brief biography of Mr. Bollman, by C. V. Riley; a review of the literature of the North American Myriapoda, by L. M. Underwood; a collection of Mr. Bollman's published writings on Myriapoda, including fifteen numbers, and a series of posthumous papers comprising eleven numbers. There is also an index to the scientific names, and the whole bulletin covers about 210 pages without illustrations.

The two separates from the Proceedings are Nos. 950 and 951. No. 950 consists of a "Descriptive Catalogue of the Harvest Spiders (Phalangiidæ) of Ohio," by C. M. Weed. The paper is descriptive in a large sense and brings together Mr. Weed's writings upon the Ohio Harvest Spider fauna, republishing his plates and figures, and bringing the whole matter into convenient shape for reference. No. 951 is a "Report on the Insecta, Arachnida, and Myriapoda" of the U. S Eclipse Expedition to West Africa in 1889–'90, by C. V. Riley. The paper includes reports upon the Hymenoptera, by Mr. W. F. Kirby, of the British Museum; upon the Lepidoptera, which could not be determined at the National Museum, by Rev. W. J. Holland; upon such of the Coleoptera as could not be determined in the National Museum, by Dr. David Sharp, Mr. Champion, Mr. Jacoby, and Mr. Gorham; upon the Orthoptera, by Mr. H. de Saussure; upon the Pseudoneuroptera, by Mr. P. P. Calvert; upon the Hemiptera, by Mr. A. L. Montandon, and upon the Arachnida, by Dr. George Marx and Mr. Nathan Banks. The Myriapoda were sent to Messrs. Cook and Collins, but on account of the delay in publication this portion was withdrawn by the authors and published elsewhere. New species are described by Messrs. Calvert, Banks, and Marx, the latter contributing a handsome plate illustrating a new genus and six new species of spiders.

EVOLUTION OF THE WINGS OF INSECTS.

Prof. J. H. Comstock, of Cornell University, has published an extremely interesting paper under the title "Evolution and taxonomy, an essay on the application of the theory of natural selection in the classification of animals and plants, illustrated by the study of the evolution of the wings of insects and by a contribution to the classification of the Lepidoptera." This paper is published in the Wilder Quarter Centennial Book, a "Festschrift" published the present autumn by some of the old students of Prof. Burt G. Wilder, of Cornell University. Prof. Comstock's paper is a very elaborate one and not susceptible of an appropriate review in the short space which we can devote to it. He argues that some effort should be made in the classification of species to learn the reasons for variations of form and in this way to judge the value of evident characters used in grouping or separating species and higher groups. He practically insists upon the study of phylogeny

as a ground work for taxonomy. He then makes an attempt to determine the phylogeny of the families of the Lepidoptera by a study of the structure of the wing, working carefully in the direction of the probable function of the component parts of this organ and thus reasoning as to the probable past action of natural selection. He realizes that in this study he is clearing up the history of but one element of the complex, but believes that the same lines will be found to govern in all and that an understanding of the development of one will lead in the same direction as regards classificatory results as an understanding of other structural features. His study of the wing of Lepidoptera has been made with extreme care. His conclusions as to evolutionary process may be questioned in some respects, particularly as to the distinction between generalized and specialized types, but the study as a whole is of the highest value. Applying the results of his study of the wings to a provisional classification of the Lepidoptera, he publishes a table of proposed divisions, simply as a record of the results obtained by his work. The table and the comments which follow are very suggestive, but, as a matter of course, it is too early to attempt their satisfactory use. Many interesting side points are brought out in the paper which will well repay careful study on the part of the student and more particularly on the part of the species grinder.

NOTES FROM THE MUSEUM OF THE INSTITUTE OF JAMAICA.

A number of the interesting stylograph sheets issued by the curator of the Museum of the Institute of Jamaica, Mr. C. H. T. Townsend, have reached us since the publication of our last number. These are Nos. 53 to 63. No. 52 relates to the Pimento Borer, a longicorn beetle (*Cyrtomerus pilicornis*), which bores into twigs of the Allspice (*Pimenta vulgaris*). No. 54 relates to the enemies of the Congo Pea (*Cajanus indicus*). No. 55 relates to the subject of Jamaican Ticks; No. 56 to the Isopod parasites of fishes; No. 57 to Erinose growths due to Mites; No. 58 to the Coco disease (*Peronospora trichotoma*); No. 59 to the Yellow-fever Fly, the Sciara, which is said to appear in swarms during yellow-fever epidemics. No. 60 is entitled "Grubs injuring roots of orange trees." These grubs are rhynchophorous, and belong to the genus *Prœpodes.* The damage seems to be only occasional. No. 61 is called "Sand Flies and Buffalo Gnats," and is general in its character, and also asks for specimens of Jamaican Simuliidæ. No. 62 is on the Tobacco or Cigarette Beetle (*Lasioderma serricorne*), which appears to be damaging stock tobacco and cigars in the warehouses in Kingston. The recommendations which have been published in INSECT LIFE are repeated. In No. 63 the writer gives a short account of the habits of *Compsomyia macellaria*, and states that in some manuscript notes made by Mr. William Jones, between the years 1835 and 1840, the larva and adult of the Screw Worm Fly are described under the name of "the maggots of the nose," and seven cases are mentioned in which it has infested man in Jamaica.

SOME JAMAICA INSECTS.

Mr. C. H. T. Townsend has lately sent us for determination a number of interesting insects from Kingston, Jamaica, with notes on their food-habits and occurrence.

From a chrysalis found on Eucalyptus he reared *Tortrix rostrana*. A species of weevil which we have doubtfully referred to *Attelabus dentipes* Fab., was stated to injure the same tree. *Apate francisca* was found boring in Lagerstrœmia, and another Ptinid, *Dinoderus brevis* Horn, in bamboo. A Formicid locally known as the "Tom Raffles Ant" proves to be *Prenolepis fulva* Mayr. An Ephestia represented by damaged specimens, but near *elutella* Huebn., was bred from "velvet-seeds," the fruit of the old-woman's tree (*Quiina jamaicensis*). This is probably the species that had damaged the "velvet-seeds" in the Jamaican exhibit at the World's Fair, as mentioned on a previous page of this number. A similar species, also in too poor condition for identification, was reared from cacao beans and is, without doubt, the same moth mentioned under 74 in the article on the insects in the foreign exhibits at the World's Fair.

INSECT NOTES FROM TRINIDAD.

Mr. J. H. Hart, of the Botanical Department of Trinidad, has begun to issue stylograph notes on the line of those which we receive from time to time from the curator of the Museum of the Institute of Jamaica, and these occasionally take on an entomological aspect. Nos. 2 and 3, which we have just received from Mr. Hart, refer to a limited series of experiments with *Attacus cynthia* and to the so-called "*Bête rouge*," which is apparently the West Indian name for one of the larval Trombidiums commonly known as Red Bugs, Jiggers, and Harvest Bugs. The species is not determined.

A COMPETITION IN ECONOMIC ENTOMOLOGY.

That very active organization, the Trinidad Field Naturalists' Club, has just instituted a competition in economic entomology, the prizes to be $30 and $20. The prizes are to be given for the best and second best essay on economic entomology, each essay to be accompanied by collections containing all of the insects mentioned, and essays and collections to be the property of the Club and to treat only of Trinidad pests.

GRAIN INSECTS IN SUGAR.

From Mr. Thomas Nixon, of Zyba, Kans., we have received the larva of *Tenebrioides mauritanicus* L. found in sugar. Its presence there was purely accidental, as the larva is undoubtedly predaceous, feeding upon the immature stages of other insects that live in stored grain and similar substances.

On a previous page of the present number, at No. 23 in the list of insects found at the Columbian Exposition, we have referred to this species. In several closed jars of sugar at the Exposition we noticed living specimens of the Rice Weevil (*Calandra oryzæ*) and one or two other species, but attached no importance to the matter as their occurrence there was doubtless due to the fact that the receptacle containing the sugar had been left standing open in the vicinity of other receptacles containing grain, flour, or other farinaceous products. No insects are known to breed in refined sugar, but some of the mites of the genus Glyciphagus, called sugar mites, infest the cheaper grades of brown sugar and the sugar of dried figs, prunes, and other fruits. The commoner species of insects that infest flour and meal, dried fruits, and the like in warehouses and groceries, such as *Plodia interpunctella* and *Silvanus surinamensis*, are often sent to us with the statement that they were found in sugar, salt and other substances that could not serve as their food. Perhaps the most remarkable case of this sort that has come to our notice is that published in Volume I of INSECT LIFE (p. 314) concerning this same *Tenebrioides mauritanicus*, which was found to have lived for some time in the insecticide, white hellebore.

EXTRAORDINARY MULTIPLICATION OF CERTAIN LEPIDOPTERA.

At a meeting of the Entomological Society of France, held October 28, M. C. Jourdheuille called attention to the wonderful multiplication of *Lasiocampa pini* L. in the valley of the Seine, where its presence had been noticed only within the last few years. It attacked not only older trees but also the young scions, involving in some cases the destruction of these last. He exhibited a twig of *Pinus sylvestris* plucked at random upon which fourteen larvæ had spun up, pressed close to one another.

The same member showed leaves of *Populus nigra* upon which were traces of thirty or forty *Lithocolletis populifoliella* Tr., an insect which has multiplied prodigiously in the valleys of the Seine and Aube. To give an idea of its inconceivable abundance, M. Jourdheuille cited two authentic instances. At Viapres on the Aube one of his friends, returning to his country house, went to light the fire when a squirming mass of these little insects, as large as his head, fell upon and extinguished the fire. Upon another occasion, returning home at twilight, he was compelled to stop, as was his horse, blinded by the swarms of the same insect, which flew into the eyes, nose, and ears of the horse and its driver, and prevented their advance.

THE POTATO-TUBER MOTH IN CALIFORNIA AND TEXAS.

The California *Orchard and Farm*, in its issue of September 15, 1893, commenting upon our editorial in Vol. v, p. 291, entitled "Legislation against Insects," states that the U. S. Division of Entomology is about

thirty years behind the common knowledge in California on the Potato-worm question. He goes on to say that potato growers have had the Tuber-worm to contend with as far back as 1856. The only specific proof of the statement as to the "common knowledge" referred to which is given is that in October, 1892, the editor, in company with Prof. C. H. Dwinelle, secured specimens of infested potatoes from J. P. Thomas, a commission merchant of San Francisco, who had known the pest for twenty-five years. We must confess that Mr. Thomas' statement is probably to be relied upon, as we know of no other insect which possesses this same habit and which could by anyone be mistaken for this species. The joke, however, can hardly be said to focus on the Division, for neither potato growers nor dealers in California seem to have been aware of the facts mentioned by the *Orchard and Farm*, and we know of no previous published records than those we have called attention to. This Division has been in active correspondence with Californians for nearly fifteen years, and no one ever sent us specimens of this insect until 1891. Two agents of the Division of Entomology have been stationed in California for seven years, and no person interested ever brought this insect to the attention of either. Through its State Horticultural Society and its State Board of Horticulture, California has been publishing matter concerning injurious insects for fourteen years, and yet no mention of this insect has ever been made in any of the reports of these organizations. A large and comprehensive work on the injurious insects of California was published in 1882 by Matthew Cooke, who for some years had been officially connected with one of the State organizations in an entomological capacity, and in this book no hint is given as to the existence of such an insect. If the persons interested in the suppression of an insect pest do not take the trouble to bring it to the attention of economic entomologists, the latter are hardly to be blamed if they remain in comparative ignorance of its existence, when, as in our case, there was no chance for personal observation.

A letter received late in September from Mr. Fritz Grasso, Baron Springs, Fredericksburg, Tex., stated that the Potato-tuber Worm was very abundant in his potato patch last year. Mr. Grasso stated that nearly every potato dug up in his patch was infested. In 1891–'92 it was present, but by no means as abundant. In the month of July the moth was noticed on the housed potatoes in "dense swarms." We have not learned from Mr. Grasso, up to the recent time, any facts as to first appearance, point of introduction, and distribution of the insect in Texas, but hope to obtain reliable information upon these points.

HYMENOPTERA FROM LOWER CALIFORNIA.

The Hymenoptera of the peninsula of Lower California have hitherto been but slightly known. Mr. Gustav Eisen, of the California Academy of Sciences, and Mr. Chas. D. Haines have collected a number of

species in this order, which have been determined by Mr. William J. Fox, of Philadelphia, and Mr. Theo. Pergande, of Washington, the latter reporting upon the ants and the former upon the other members of the order. Their papers are published in the proceedings of the California Academy of Sciences, Vol. IV, second series, and reprints have been received from both authors.

ANTS AND THE FRUIT-GROWER.

Items concerning the offices of ants in the orchard and garden are constantly being published in the horticultural and agricultural press, and the most diverse opinions are expressed. We happened among our recent newspaper clippings to find two absolutely contradictory statements, the one entitled "Ants a Help to Fruitgrowing," in which the author states that ants are of the most valuable assistance to the farmer by acting as perpetual insect destroyers, the other referring to damage done in vegetable gardens in the way of eating lettuce seed and other small seeds, and "sucking the life out of acres of young cucumbers and melon plants." The truth of the matter is that, on the whole, ants do more harm than good. It is true that they destroy a certain number of injurious insects, but they likewise carry off small seed, and frequently ruin lawns and flower beds. The principal damage which they do, however, aside from their work as household pests, is in their care of injurious plant-lice and bark-lice, and in their great assistance in spreading these insects. They are probably responsible for the greater part of the damage done by several species of plant-lice. It has been recently proved, for example, that the common Corn-root Plant-louse would have difficulty in hibernating if it were not for the fact that its eggs are carried into the nests of the little brown *Lasius alienus*, and there cared for during the winter.

CANADIAN SAW-FLIES.

Under the title "Fauna Ottawaensis, Hymenoptera Phytophaga," Mr. W. Hague Harrington published in the *Ottawa Naturalist* for November, 1893, an important list of the saw-flies and horn-tails which he has collected in and around Ottawa. The list comprises 166 species, and indications are given of date of capture, and a few other notes as to food habits are scattered through the list.

CHILEAN ODYNERIDÆ.

Mr. Edwyn C. Reed has just published in the Anales de la Universidad, a paper entitled "Synopsis of the Chilean Wasps of the Family Odyneridæ," forming a portion of a series which he intends to call "Chilean Entomology." The paper consists mainly of a bringing together in synoptical form of the species heretofore described by other authors, and three new species are characterized.

LOWNES'S MONOGRAPH OF THE BLOW FLY.

The fourth part of Mr. B. T. Lownes's very elaborate monograph on the Anatomy, Physiology, Morphology and Development of the Blow Fly (*Calliphora erythrocephala*) has been recently received. If we understand the author's intention, the first three parts are to constitute Vol. I, and the fourth, with one or more parts yet to be published, Vol. II, of the Monograph. The first volume deals with the subject generally, with the anatomy of the larva, the development of the embryo in the egg, and of the nymph in the puparium, as well as with the external skeleton of the perfect insect. The second volume deals with the various internal organs, their development and physiology, and part 4, the first part of this volume, treats of the tracheal system, the alimentary canal, and the nervous system. The author, in connection with the various chapters, gives résumés of the principles of anatomy, morphology, and histology as applying to insects in general, as a sort of introduction to the specific consideration of the form studied. With each of the four parts so far issued is given a short appendix, with useful details of the methods of study followed by the author, including directions for the preparation and mounting of the tissues for microscopic study. Scattered throughout the publication is also a very extensive bibliography which the author intends shall ultimately include all of the works on the subject which he has consulted, or all which possess historic interest and contain original work. The extent of the monograph may be gathered from the fact that it has already reached nearly 500 pages, with 33 plates and 61 text figures. The illustrations are reproduced directly from the drawings of the author, and while not as finished as might be wished, are sufficiently well made to convey the information intended. It is a well-printed work, and will be a very valuable addition to our knowledge of the morphology and physiology of insects.

HIBERNATION OF THE ORANGE FRUIT FLY.

Mr. S. D. Bairstow, in the *Agricultural Journal*, of the Cape of Good Hope, for November 2, 1893, states that he has shown by breeding-cage experiments that *Ceratitis citriperda* hibernates in the adult condition under dead leaves and other débris, the flies disappearing into hibernating quarters during April and emerging in October and later.

FOR PLANT-LICE IN GREENHOUSES.

Col. Wright Rives, of Rives Station, Md., has for some time past obtained most excellent results in his extensive greenhouses in fumigating with tobacco smoke against the "green fly" (plant-lice in general). Most methods of fumigation result in some danger to the plants on account of the "heat" of the smoke. Col. Rives fills a flower-pot with tobacco dust, packs it in firmly, and inverts it, leaving the dust in

the form of a truncate cone. He then sticks his finger into the apex of the cone, making a hole half an inch in depth, into which he pours half a teaspoonful of kerosene. He leaves it a few minutes and then lights it with a match. The resulting smoke is dense and cool and the cone burns down to the ground.

AUSTRALIAN PARASITES OF VERTEBRATES.

Apropos to the description of a new flea from New South Wales, Mr. F. A. A. Skuse, in the Records of the Australian Museum, Vol. II, No. 5, gives a list of the insect parasites of Vertebrates which he knows to occur in Australia. The new flea occurs on the body of the Australian Tiger-cat, and for it Mr. Skuse erects the new genus Stephanocircus, characterized chiefly by the absence of eyes in the female and the possession of an exerted cap-like patella in the front of the head. Among the animal parasites he mentions the common Sheep and Horse Bots, two species of the Oscinid genus Batrachomyia, the larvæ of which live under the skin of frogs, two species of Hippobosca, five of Ornithomyia, the common Sheep Tick, a single species of Olfersia, five fleas of the genus Pulex, one of the genus Echidnophaga, occurring upon the Australian Porcupine, the common Bed Bug, the head, body and crab Lice, and of other lice two species of Philopterus on chickens and pigeons and five of Trichodectes on domestic animals. Most of the latter are of wide distribution and by no means confined to Australia.

KEROSENE EMULSION AGAINST SHEEP TICKS.

A recent writer in the *American Agriculturalist* speaks highly of kerosene emulsion for killing sheep ticks. He has tried a score or more of remedies and finds that this has the advantage of cheapness, ease of application, harmlessness to the animal, and efficiency against the ticks. Instead of dipping the animals, which the average sheep raiser considers altogether too much trouble, he crowds the sheep into some corner or pen, so as to bring them into a compact body, and then sprays the emulsion over them until they are thoroughly wet, the flock being occasionally moved about so as to expose all parts of the body. We are glad to see this practical testimony, since, although the effectiveness of the remedy was proved some years ago by Messrs. C. P. Gillette and Cooper Curtice, the late tendency of Experiment Station entomologists has been to depreciate the use of the emulsion on account, as they say, of the difficulty which the ordinary individual has in making a perfect emulsion. As we have stated on two occasions before the Association of Economic Entomologists, we do not consider this a valid reason for refraining from recommending an efficient remedy. The farmer must be induced to take a little pains in this matter. He must be shown that it is not difficult when properly undertaken and he must, in fact, be educated up to its use.

THE ORTHOPTERA OF THE GALAPAGOS ISLANDS.

We have received from Mr. S. H. Scudder a paper with the above title extracted from Vol. xxv of the Bulletins of the Museum of Comparative Zoology, Harvard College. The author reviews all previous accounts of Orthoptera from these Islands and reports the results of his own examination of material recently collected by the Fish Commission Expeditions. Specimens of all but one of the species ever reported have been examined. Excluding the Cockroaches, but fifteen species have been found upon these Islands and all are distinctly South and Central American in their affinities, five being apterous or subapterous forms. This large proportion of forms incapable of flight is accounted for in Mr. Scudder's mind by the supposition that the Galapagos are of very recent origin and have obtained their present Orthopterous fauna by chance advent of pregnant females as waifs from the nearest shore or the shore which the currents of the ocean make practically the nearest. The paper includes the description of a new species of Earwig, a new genus and two new species of Mantidæ, three new genera and three new species of Acridiidæ, one new genus and two new species of Locustidæ and one new species of Gryllidæ. The new forms are illustrated upon three well-executed lithographic plates.

OBITUARY.

Dr. Herman August Hagen, professor of entomology in Harvard University and curator of the insect collection of the Museum of Comparative Zoology at Cambridge, died November 9, at the age of 76. Dr. Hagan was a well-known German entomologist residing in Königsberg, when, in 1868, he was invited by Louis Agassiz to come to Cambridge as assistant in entomology. His residence in this country has since that time been continuous. He was probably the most learned student of the Neuroptera that the world has seen, but was also a general entomologist of wide attainments. His familiarity with the literature of entomology was extraordinary, and his Bibliotheca Entomologica, published in 1866, has always been the first requisite on the working table of entomologists of all countries. A long and painful illness had incapacitated Dr. Hagen from work for the past two years, and the duties of the position have of late been performed by Mr. Samuel Henshaw, who we hope will permanently succeed to the position, as he is in every way competent to fill it.

We have also to record the death of Mr. Wilhelm Juelich, at his home in New York City, November 8, 1893, at the age of 54. Mr. Juelich was a native of Germany, but came to this country in his boyhood. He began the collection of Coleoptera before the War, and at the time of his decease his cabinet was one of the largest in this order in this country. It was particularly rich in the Rhynchophora and in several families of micro-coleoptera. He was a member of the entomo-

logical societies of New York, Brooklyn, Newark, Philadelphia, and Washington, and had published a number of interesting articles on his favorite topic in *Entomologica Americana* and other periodicals. He was widely known as an enthusiastic collector, and in the earlier work of Drs. LeConte and Horn, and in the later work of Capt. Casey, contributed much assistance in the donation and loan of material for description and study.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

December 7, 1893.—Mr. G. B. Sudworth was elected an active member. Mr. R. H. Wolcott, Grand Rapids, Mich., was elected a corresponding member. The election of officers for 1894 resulted as follow: President, William H. Ashmead; vice-presidents, Theodore Gill and C. L. Marlatt; recording secretary, L. O. Howard; corresponding secretary, F. H. Chittenden; treasurer, E. A. Schwarz; additional members executive committee, George Marx, B. E. Fernow, and C. V. Riley.

Mr. Marlatt read a paper entitled "Revision of the genus Pontania, Costa, with Descriptions of New Species." This genus is an off-shoot of the old genus Nematus, containing the small species of gall making habits. Seventeen species belonging to the North American fauna were described. Discussed by Prof. Riley.

Mr. Chittenden presented by title a paper on the habits of some Coleoptera, which was referred to the publication committee.

Mr. Howard presented a "Note on the mouth-parts of Stenopelmatus," describing the trophi of this genus and calling attention to an abnormal asymmetry in the galeæ.

Mr. Fernow spoke in regard to "antinonnin," a new insecticide recently introduced into this country. Discussed by Messrs. Riley, Waite, and Swingle.

Two short notes by Mr. A. D. Hopkins were read by the Secretary, the first describing a new Scolytid—*Corthylus columbianus* which affects oak timber. The second note was on the food-habits of *C. punctatissimus,* which was found to breed in small bushes of Dogwood, Hazel, Sassafras, Water Beech, Sugar Maple, and Ironwood.

Mr. Heidemann exhibited a series of Capsids allied to *Lygæus turcicus,* all of which he considered as varieties although several of them have received specific names.

Mr. Ashmead exhibited a Chalcidid which he considered as identical with Fabricius's *Chalcis cyaneus,* and stated that the species belongs to *Chryseida* Spinola. He also stated that this genus belongs to the Eurytominæ instead of to the Perilampinæ, in which it is placed by Westwood.

C. L. Marlatt,
Recording Secretary.

January 11, 1894.—A letter from Mr. A. D. Hopkins, of Morgantown, W. Va., was read by the Secretary, announcing the discovery of a Tulip tree more than 400 years of age, in which the work of *Corthylus columbianus* Hopkins mss., dating back to pre-Columbian times, has been found.

The resignation of Mr. F. H. Chittenden as corresponding secretary was accepted and Frank Benton was elected to fill the vacancy.

The annual address of the retiring president, Prof. C. V. Riley, was then delivered. The title was "Natural Selection as applied to Longevity in Insects." The treatment of the subject comprised an extensive review of the length of life of the different stages of insects of all orders, including an elaborate history of the larval life of *Cicada septendecim,* introducing many new facts, and describing in detail the larval stages. He felt that Weismann had made a mistake in considering only the longevity of the adult in insects and showed that it was very generally true that

the term of larval life is prolonged proportionately to its dim... e adult, and *vice versa*. While dissenting thus in some minor particula... ...mann's views, he, nevertheless, believes that this author has made out a ... t the length of life in animals has been very largely regulated by the ne... ...on-ditions of life and chiefly through natural selection. The conclusio... ...m other animals are particularly justified when insects are considered, ... s cases particularly of retarded development under exceptional conditio... the great elasticity possessed in this particular by insects upon which na... tion could play. Discussed by Messrs. Fernow, Schwarz, and Ashmead.

February 1, 1894.—Mr. H. G. Hubbard read a paper on the "Oviposition o... *ra prodenialis* Walk.," a Phycid moth whose larvæ bore into the pads of d... species of Opuntia in Florida, and the eggs of which are laid in a long stick or ... Discussed by Messrs. Howard, Gill, Schwarz, Riley, Ashmead, and Stiles.

The Corresponding Secretary read a letter from Mr. T. D. A. Cockerell upon ... "Hymenoptera of Jamaica," in which all of the species observed by the writ... were listed and the character of the fauna was compared with that of North America and the other West Indian Islands. Discussed by Messrs. Hubbard, Schwarz, Riley, Ashmead, Howard, and Gill.

Mr. Schwarz read a communication entitled "Notes on Melsheimer's Catalogue of Coleoptera published in 1806," exhibiting a copy of the catalogue which had been in the possession of Melsheimer and his two sons and which had been annotated in manuscript by J. F. Melsheimer. Mr. Schwarz commented at some length upon the footnotes given by Melsheimer to some species, mostly of economic interest. Discussed by Messrs. Riley and Waite.

Under the head of Exhibition of Specimens and Short Notes Dr. Marx exhibited an enlarged figure of a remarkable spider of the family Oonopidae which differed from all known forms in having a sclerite between the coxa and the sternum. Discussed by Messrs. Schwarz, Gill, Riley, and Ashmead. The secretary exhibited two figures sent in by Mr. Hopkins and which indicated the holes and stains made by *Corthylus columbianus* in the tree mentioned at the preceding meeting. Mr. Ashmead exhibited specimens of *Eudoxinna transversa* Walk., and a new genus of the Proctotrypid subfamily Diaprinne which he proposes to call Notoxoides. Mr. Hubbard exhibited specimens of *Doryphora decemlineata* collected at Fort Assiniboine, Mont., and which had not come in contact with the cultivated potato.

L. O. HOWARD,
Recording Secretary.

SPECIAL NOTES.

Eighth and Ninth Reports of the New York State Entomologist.—We have just received from Dr. J. A. Lintner copies of his long-delayed eighth and ninth reports as State Entomologist of New York, the eighth report covering the year 1891 and the ninth 1892. They are extracted, respectively, from the forty-fifth and forty-sixth reports of the New York State Museum and are published with both paper and cloth bindings. Both reports show Dr. Lintner's usual great care and attention to detail, and his bibliographical lists of the most prominent insects treated not only indicate his great familiarity with the literature of economic entomology, but afford the greatest service to the working entomologist. The paper, type, and printing are all good, and each report, as in previous years, contains much interesting matter in appendix form, including reprints of the addresses delivered by Dr. Lintner during the year, and a complete summarized list of his publications. The ninth report contains, in addition, a reprint of Dr. Fitch's rare catalogue of the Homoptera of New York, with critical remarks upon the synonymy of the species, including corrections and notes, by E. P. Van Duzee and C. V. Riley. The principal insects treated in the eighth report are, the Raspberry Geometer (*Synchlora glaucaria*); the Birch-leaf Bucculatrix (*Bucculatrix canadensisella*); the Pear Midge (*Diplosis pyrivora*); two Frog-hoppers (*Clastoptera obtusa* and *C. pini*); the Comb-horned Fish-fly (*Chauliodes pectinicornis*); the Horned Corydalus *Corydalus cornutus*); the Lunated Long-sting (*Thalessa lunator*); the Currant Stem-girdler (*Janus flaviventris*); the Larch Saw-fly (*Nematus erichsonii*); and a number of other insects which receive briefer treatment. Those treated in the ninth report are, two Carpet Beetles (*Anthrenus scrophulariæ* and *Attagenus piceus*); the American Meal-worm (*Tenebrio obscurus*); the Cluster Fly (*Pollenia rudis*); the Pear-tree Psylla (*Psylla pyricola*); and the Green-striped Locust (*Chortophaga viridifasciata*).

Report of the Official Entomologist of the Dominion of Canada.—Mr. James Fletcher sends us the author's edition of his report as Entomologist and Botanist to the Central Experiment Farms at Ottawa, and in the entomological portion he gives excellent articles upon Cut Worms, the Red-legged Locust, granary insects, and a number of less important species which he treats under the respective heads of species injurious to root crops, fodder crops, vegetables, fruits, forest trees, and live-stock. The report contains a number of interesting notes, one of the most important of which refers to the Black Vine-weevil (*Otiorhynchus sulcatus*), a beetle common to Europe and North America, and which, in Europe, does considerable damage to the vine. Mr. Fletcher has received specimens from Victoria, B. C., which were feeding on the roots of Cyclamens in greenhouses. The species now occurs in British Columbia and Nova Scotia, as well as the New England States. Its occurrence in the East is supposed to be from accidental introduction, and it may equally as well have been introduced at Victoria, although Mr. Schwarz is inclined to think that it is native to North America and a member of the circumpolar fauna. The Horn Fly has increased enormously and spread rapidly throughout the provinces of Ontario and Quebec, and in some districts the milk supply was reduced one-half. Mr. Fletcher finds that when the flies are at their worst it is necessary to spray cattle with ordinary kerosene emulsion every two days. Tanner's oil, however, containing some carbolized oil, or oil of tar, is more lasting in its effects, but takes longer to apply and requires much greater labor.

Miss Ormerod's S venteenth Report.—The somewhat anomalous annual report published by Miss Ormerod upon the injurious insects and common farm pests of England, for the year 1893, has just reached us. We call this report anomalous for the reason that, as we have previously mentioned in these pages, Miss Ormerod's work is gratuitous and her report is published at her own expense. She has devoted her labors to the good of the agricultural classes of England in the most philanthropic and praiseworthy manner. She stands almost alone in economic entomological work in England. Her report for 1893 fully sustains the generally excellent character of the series, and while few of the insects treated occur on this side, several of them have their vicarious forms with us, and the report is therefore, of much interest to American workers. One of the most interesting articles in the report is that upon wasps, in which Miss Ormerod treats at length of the extraordinary abundance of species of the genus Vespa, not only in England but in other parts of Europe during the season of 1893. This abundance was productive of much more harm than good, for while the species kill other insects, they inflict, when excessively abundant, a great amount of injury in the way of loss to fruit-growers and much

inconvenience and pain by their attacks upon men and horses in the field, as well as by their extraordinary infestation of houses. The reason for this extraordinary abundance of Vespidæ is supposed by Miss Ormerod to be the long-continued dry weather of the spring. It seems there were not the "usual intervals of cold and wet to catch and destroy the queen wasps, when warmed into active life and drawn out from their winter shelters by what in most years is an alternation of sunshine with weather that leaves the houseless queens between whiles exposed to just the conditions unfavorable to their own existence and likewise to that of their embryo nests."

Monograph of the Phycitinæ and Galleriinæ.—A very important work on these two sub-families of the Pyralidæ has recently come to us through the courtesy of its author, M. E. L. Ragonot, of Paris. It is published at St. Petersburg as Part VII of the *Mémoires sur les Lépidoptères* issued under the auspices of the Grand Duke Nicolas Mikhailovitch. The history of the preparation of the monograph is given in the preface, and in a long introduction a full discussion of the sub-families and of the generic characteristics is given. This introduction, with its synoptic tables, will prove invaluable to all students of the groups. The balance of the monograph, some 658 pages, is taken up with full descriptions of the species, the generic diagnosis accompanying the consideration of each genus. There are 23 chromo-lithographic plates, admirably executed, with sufficient detail of structure to make them extremely valuable for identifying species. The first three are devoted entirely to structural details, while the balance are colored figures. These are arranged very tastefully, and by giving only the body and one pair of wings, a great many figures are crowded on each plate, while at the same time a certain harmony of arrangement has been maintained by the wings on either half of the plate opposing each other.

One of us has followed M. Ragonot's work for many years now, having had a pleasant personal intercourse and correspondence with him. We know how faithfully and diligently he has worked, and of late years under many difficulties of poor health and confinement; and we congratulate him and Lepidopterists generally upon the final issue of his efforts. Such monographs as these give dignity to and advance the science of Lepidopterology. We regret that the fashion has been followed of printing specific names in capitals, and although the author has done this to conform to the preceding volumes of the *Mémoires*, he nevertheless inclines to defend it, though he would have preferred confining the capital letter to proper names. He fails to see the utility of uniformly dropping the capital letter for specific names, and gives as the chief reason for opposing this custom, which is spreading, that it becomes impossible to recognize those species, of which the names

should recall those of well-known entomologists, or serve to honor the names of the originators. This remark indicates how prevalent yet the idea seems to be that natural history names are for the purpose of honoring those who coin them, or those for whom they are coined, rather than of advancing knowledge.

The San José Scale in the East.—When we announced, at the meeting of the American Association for the Advancement of Science last summer, that the San José Scale (*Aspidiotus perniciosus*) had been found in the vicinity of Charlottesville, Va., we were not aware that this species had obtained a foothold at other points in the East; but during the month of March of the present year specimens of this insect were received from De Funiak Springs, Fla., and from Charles County, Md., with reports indicating that very considerable damage had already been done in both localities. In April it was received from Lewisburg, Pa., but is apparently limited to a few pear trees and one apple tree. Since the publication of the last number of INSECT LIFE, in which reports from Messrs. D. W. Coquillett and E. A. Schwarz were printed, the Division has, with the aid of the Virginia State Board of Agriculture, conducted fumigating operations at Charlottesville, which we hope have stamped out the insect in that locality. A report on these operations is given in this number. Careful study is now being made of the occurrences in Florida and Maryland, and in the latter case, on account of its proximity to Washington, the insect will be most carefully watched, and exterminated if possible.

The almost simultaneous appearance of the insects in great numbers in these three widely separated localities indicates that there is every probability that it exists at present in other—perhaps many other—eastern orchards. In Virginia and Maryland the insect was undoubtedly introduced upon nursery stock purchased from eastern nurserymen. More of this same stock must have been sent out at about the same time. In view of this strong probability notices have been sent to all the agricultural newspapers describing the scale and urging fruit-growers to examine their orchards carefully and report to the Department. An emergency bulletin, condensed from the forthcoming annual report of the Entomologist, and giving a complete account of the insect and the best remedies to be used against it, has been prepared and is ready for distribution to all applicants. It is too early to predict the consequences of the appearance of this extremely destructive species on the Atlantic coast, but the Department will do all it can to aid those concerned in stamping it out, as it has done at Charlottsville.

A NEW AND DESTRUCTIVE PEACH-TREE SCALE.

(*Diaspis lanatus* Morg. and Ckll.)

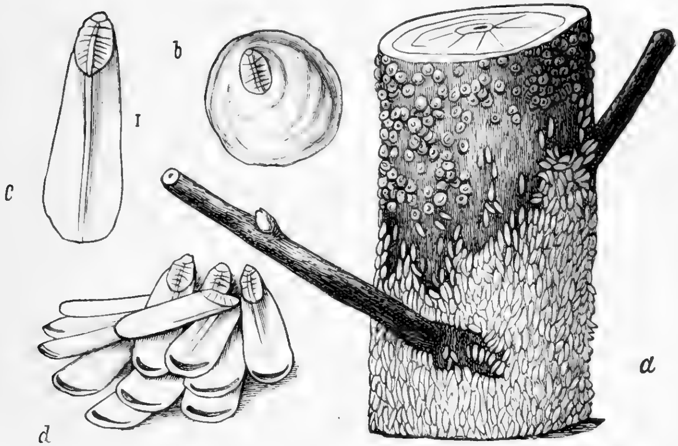

FIG. 12.—*Diaspis lanatus: a*, section of peach trunk with male and female scales *in situ*—natural size; *b*, scale of adult female; *c*, do. male; *d*, do. in natural position—enlarged (original).

An interesting and destructive bark-louse has recently made its appearance in certain portions of the Atlantic States. Its life-history has been carefully investigated during the past year, and some account of the species has been prepared for the Annual Report of the Department for 1893, now in the printer's hands. The more technical portions of the investigation, including the full and detailed descriptions of the different stages of the insect, were necessarily omitted from this report, however, and on account of their scientific importance we introduce them here.

DISCOVERY, OCCURRENCES, AND LIFE-HISTORY OF THE SPECIES.

In regard to the discovery and occurrences of the species, and its previous history, we may briefly summarize for the purposes of this article, as follows:

Certain seedling peaches, growing in rows on the grounds of the U. S. Department of Agriculture, were found in 1892 to be badly affected by a scale-insect which was recognized as new to the fauna of the United States. The young trees were badly damaged, and the lower halves of the trunks of many of them were covered with the scale-insects, which were present in extraordinary numbers, giving the worst-infested trees the appearance of Fig. 12. The young twigs of these trees were already dead and dry. The species was found to be identi-

cal with *Diaspis lanatus* Morg. and Ckll., first described in the *Journal of the Institute of Jamaica.* *

In Jamaica, according to Mr. Cockerell and his successor, Mr. Townsend, the insect occurs upon Grape, Bastard Cedar (*Guazuma ulmifolia*) *Cycas media*, Capsicum, *Argyreia speciosa*, the bark and twigs of an undetermined malvaceous plant, *Bryophyllum calycinum*, Peach, Pelargonium, Jasminum, stems of Cotton, *Calotropis procera* (French Cotton) and *Hibiscus esculentus.* In Trinidad it occurs upon *Carica papaya*, according to the observations of Mr. F. W. Urich. Acanthus, Peach, and Sedum are added by Mr. Townsend in the last number of the Journal of the Institute of Jamaica (Vol. I, No. 8), and the Entomologist found the species excessively abundant on several of the above-mentioned plants during his recent trip to the West Indies. Two of the oldest Cycads (*Cycas circinalis*) in the once celebrated but now much neglected botanical garden at St. Pierre, Martinique, were seriously affected, the bracts being white with the male scales and entirely killed. It was also bad on *Zamia mexicana*, upon which the director, M. Eugene Nolet, thinks it was introduced to the garden.

In this country it was received in September, 1893, from Mr. S. F. Harvey, of Molino, Fla., and in October of the same year from Mrs. E. Johnson, of Bainbridge, Ga. The origin of the Washington specimens above referred to has not been ascertained, although every effort was made to learn the source from which they came. The rows of young trees were started by assistants in the Division of Vegetable Pathology, for the purpose of inoculation with Peach Yellows and other diseases of the Peach, which that Division was engaged in studying. The trees were raised from seed, and in consequence most careful search was

* The question as to the proper authority for the name of the insect is an interesting one. Mr. Cockerell gave the species the manuscript name of *Diaspis lanatus* and drew up figures and descriptive notes He sent specimens to Mr. A. C. F. Morgan, a well known English writer on Coccidæ, at present located at Oporto, Portugal, who, in his reply, sent Mr. Cockerell a full manuscript description of the species. Mr. Cockerell preferred this description to his own, and wrote to Mr. Morgan proposing that, as he was using the latter's description of the species, it should be credited to Morgan and Cockerell. Mr. Morgan replied that he preferred not to be cited as the authority unless he published the species in a paper of his own. However, Mr. Cockerell published Mr. Morgan's description in the *Journal of the Institute of Jamaica*, as above cited, heading it simply "*Diaspis lanatus* n. sp.," in an article treating of Coccidæ of which he was himself the author, but stating that this description had been sent to him by Mr. Morgan. In the course of the description Mr. Cockerell inserted certain bracketed descriptive passages of his own, and in deference to Mr. Morgan's desire has since referred to the species in correspondence and in print as *Diaspis lanatus* Cockerell. Dr. David Sharp, in the *Zoological Record* for 1892, refers to the species as *Diaspis lanatus* Morgan, n. sp., probably overlooking the fact that the description contained bracketed passages of Mr. Cockerell's authorship. In the face of this curious complication, it seems best to consider the species as one of dual authorship—*Diaspis lanatus* Morgan & Cockerell. It may seem unnecessary to devote so much attention to a point of such small importance, but as a matter of fact the circumstances are almost unique in descriptive entomology.

made for specimens of the insect upon neighboring trees of other varieties. The entire part of the grounds in the vicinity of the trees was searched without result, and the superintendent of the grounds assures us that no changes have been made in the surrounding vegetation since the peach plantation was started. The only plants in the immediate vicinity are a large evergreen hedge, an Osage orange hedge, some young fig trees, and a few grape vines, in addition to the ordinary couch grass and clover, and a few chenopodiaceous weeds. It is possible that the young larvæ may have been brought from a distance upon the feet of birds or upon winged insects, but it is hardly possible that the species, if occurring in any numbers, should not have been discovered, even a block or more away. Later it was found that although the peaches were all seedlings, a few very small twigs and buds had been brought from Delaware for inoculation purposes by Dr. Erwin F. Smith, and a few more from Still Pond, Md. This introduces the possibility that the insect may have been brought upon these small pieces of Peach, but Dr. Smith is a very keen observer and has paid a great deal of attention to insects, and he assures us that the specimens brought were not affected by this insect. Moreover, he has, he says, a most intimate acquaintance with the orchards from which the twigs and buds were brought, and that the occurrence of the Diaspis in either of these orchards would certainly have attracted his attention. The origin of the infection on the Department grounds is, therefore, still obscure.

A similar attempt was made to ascertain the origin in the cases of Mr. Harvey and Mrs. Johnson, and it was learned from correspondence that in the former case they first made their appearance upon some young trees, Peach and Plum, which he had received from California about February, 1888. They were set out and made good growth that year, but upon looking them over in the fall he discovered some dead wood and even dead branches covered with scales. He cut off the dead wood and washed the trees carefully, as he found the scale upon all parts. During the summers of 1889 and 1890 whenever he found a tree infested, he took it up and burned it. During the winter of 1890–'91 he gave orders to have all the California peach and plum trees cut out. They were set out in a pear orchard, with no other peaches or plums in the immediate neighborhood. Something over one hundred were thus destroyed. In 1892 he found several large two and three-year old peach trees covered with the scale. They were half a mile from the spot where the California trees had stood. In the early part of 1893 he found the insect scattered over the orchard; not on all the trees, but here and there throughout an orchard of two to three thousand trees. In September it had made very considerable progress. Up to June he had no doubt that he had brought the scale from California, but during that month he visited several orchards 80 miles to the east, and found the scale at that point. He was informed that none of

the growers in that vicinity had received any young trees from California. He thinks that the insect prefers the Plum, especially the rapid-growing Japanese plums. They were very abundant upon sprouts putting out from the crowns of three hundred old peach trees which he topped two years before. These sprouts were covered with the scale, while the new tops and the old stumps were free, even when the sprouts had run up into the new top of the stump. All these sprouts were grubbed out.

In Mrs. Johnson's case the statement was made that she found it attacking plum and peach trees in her orchard. Upon further inquiry it was ascertained that about four years since she purchased a small lot of peach and plum trees from a nurseryman in Thomasville, Ga. The following summer she noticed that one of the trees (a Chinese Blood Peach) was badly infested with the scale-insect. Some ineffective attempts at remedial work were made, but the insect gradually covered the tree, and in the summer of 1891 she cut it down and burned it. In the meantime she had enlarged her orchard with trees from nurseries at Augusta and Waycross, and at about the time when she cut down the first peach tree she discovered that a plum tree near by was also affected. Since that time she has endeavored to destroy the scale, but at the time of writing it was present on from 25 to 30 trees. A later letter from Mrs. Johnson states that upon inquiry she had found that one of her acquaintances has had some trouble with this insect, and that this individual purchased the plum tree upon which it was first discovered from the same Thomasville (Ga.) nurseryman from whom Mrs. Johnson thinks she received her original stock.

Other Species on Peach.—Mr. Henry Tryon has found in Queensland a species of Diaspis occurring upon Peach, which he described as *Diaspis amygdali*. He recorded it in his Report on Insects and Fungus Diseases No. 1, as occurring at Brisbane, Queensland, and Sydney, N. S. W., and as doing a very considerable amount of damage. This species has unfortunately been introduced into California, and was found by Mr. D. W. Coquillett in February, 1893, at Los Angeles, upon a dwarf flowering almond recently imported from Japan. Japan, therefore, may be the original home of the species, and it may have been imported from that country into Australia. Signoret, in the Annales de la Société Entomologique de France (1869, p. 437), describes *Diaspis leperii* as occurring upon Peach in Europe. The common Rose Scale (*Diaspis* [*Aulacaspis*] *rosæ*) also occurs sparingly upon other rosaceous plants, including the Pear.

A Dangerous Species.—From the above facts it is evident that the species is a very general feeder, and, as a consequence, much more dangerous than if it had but one or two food-plants, as it will be all the more difficult to stamp it out or prevent its reintroduction. So far, it is true, it is reported upon but one or two food-plants in this country, but we shall no doubt before long hear of it upon many others, unless,

indeed, it can be eradicated from the localities in which it has obtained a foothold. There can be little question that it is a West Indian species, and that it has been brought into this country by some of the southern importers of West Indian and other tropical and sub-tropical plants, and the Thomasville (Ga.) nurseryman above mentioned is open to at least a strong suspicion of the responsibility, whether direct or indirect. The fact that it thrives as far north as the District of Columbia adds to the seriousness of the case and to the great desirability of eradicating the species upon its first appearance in any one locality. It is in the hope of helping to bring about such a consummation that we have given this extended notice with illustrations of the species in this article. Proper measures have been taken to stamp it out at Washington, and the correspondents in Florida and Georgia have been urged to do likewise. Nevertheless it seems to us that it has already obtained such a foothold as to make it highly improbable that it will be eradicated. It multiplies with surprising rapidity, since, as we shall presently see, there are from three to four generations annually at Washington.

Life History.—When the insect was first discovered, in December, 1892, the lower halves of the trunks of the young peach trees were more or less completely covered with male scales, while the female scales mainly occupied the trunk in its upper half. In March the female scales were examined and the eggs were plainly seen within their bodies by transmitted light. By the end of April they were found to be full of eggs which appeared to be perfectly developed, although none had been deposited upon April 24. Upon May 5 oviposition had begun, and upon May 13 the young larvæ were hatching by thousands. At this time experiments were made to ascertain whether these larvæ would settle upon Rose. A potted rose, free of scale, was tied to a badly infested peach tree, but none of the young scales migrated to it, although it was examined for ten days or more. The larvæ developed irregularly, and by May 23 some were already twice as large as others, and all seemed to be covered more or less densely with glistening white threads, while a few had begun to form a delicate scale. By May 26 a few had cast their first skin. By June 15 the females had cast their second skin, while the male scale was fully formed and most of the male larvæ had transformed to the pupa state, a few having already become winged. The next day many males issued. About the end of June oviposition began again, and the females attained full size at the middle of August, egg-laying for the third time beginning at the end of August. Another brood developed at the end of October.

Natural Enemies.—No parasites have as yet been bred from this species, and but one predaceous insect has been seen feeding upon it. Late in the fall of 1893 a number of adult specimens of the Twice-stabbed Ladybird (*Chilocorus bivulnerus*) were seen gnawing into the adult female scales at Washington.

DESCRIPTION.

Scale of Female (Fig. 12, *b*).—Rather more than a millimeter in diameter; considerably convex; grayish white in color; exuvia of larva rather more than half way between center and anterior margin. The whole scale covered with a thin layer of the outer skin of the bark. Exuvia dark orange yellow, brownish along sutures, and frequently with a brown spot in the middle; naked, glossy, smooth.

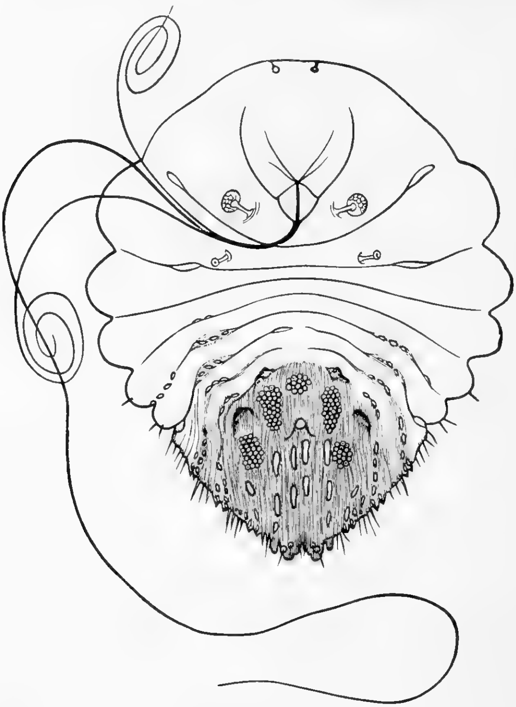

FIG. 13—*Diaspis lanatus:* Adult female, ventral surface—greatly enlarged (original).

Female (Fig. 13).—Color bright orange; shape broad oval, rounded anteriorly and obtusely pointed posteriorly; anal plate brownish; segments of abdomen very distinct throughout their entire length, and, in drying, the lateral margin of abdomen becomes somewhat serrate through indentation of sutures at margin; dorsum with two distinct impressed subdorsal lines and with a quantity of glistening, white, delicate, fibrous, waxy secretion on each side of these subdorsal impressions from fifth segment, leaving the median space and disk of anal plate including pores naked; five rather distinct groups of pores of extremely variable numbers; anterior group composed of 10, 12 to 18 or 20; anterior lateral groups of from 23 to 32, and posterior lateral from 22 to 32; anterior group transversely oval, lateral groups longitudinally oval; those on each side being nearly confluent; four distinct lobes each side of tip of anal plate; median lobes much incised for half their length

FIG. 14—*Diaspis lanatus:* Fringe of anal plate of adult female—greatly enlarged (original).

with their apical margin somewhat scalloped (see Fig. 14); second pair of plates with inner margin nearly straight, outer margin with two rounded incisions making three rounded sub-lobes; third and fourth lobes acutely dentate, third with one tooth and fourth with three; spines small, rather stout; four lateral spines on eighth segment, five or six on seventh, five or six on sixth, and two each on five and four; in anal plate, on each side exterior to lateral groups of pores (or spinnerets) is a longitudinal row of five narrow, oval, obliquely placed, transparent spots, resembling minute spiracles. Whole surface of body finely, microscopically shagreened.

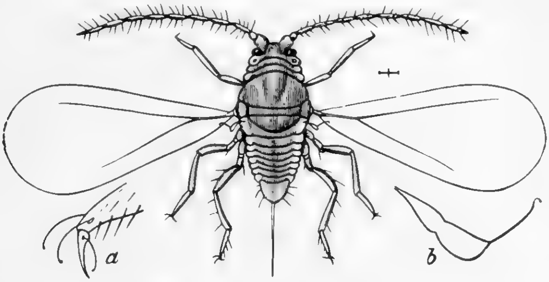

FIG. 15.—*Diaspis lanatus*: Adult male—greatly enlarged; *a*, tarsus; *b*, poiser or balancer—still more enlarged (original).

Scale of Male (Fig. 12, *c*, *d*).—Color pure white. Larval exuvia pale yellow, much lighter in color than that of female. Median carina rather feeble, but extending the whole length of scale. Sides subparallel, slightly diverging in a few specimens. Length rather more than a millimeter; width one-third length.

Male Pupa.—Pale orange in color; eyes purplish black; all limbs white.

Adult Male (Fig. 15).—Length of body, exclusive of style, 0.4 ^{mm}; style 0.2 ^{mm}; expanse 1.2 ^{mm}. General color bright red, sides of abdomen whitish, anal segment yellowish, all legs and antennæ yellowish; eyes dark purple; wings colorless. Antennæ ten-jointed, joints 3 to 10 long, elliptical, subequal in length, scape large, joint 2 very small; legs short, tibiæ a little longer than femora, tarsi about half as long as tibiæ; tarsal claw slender with three digitules. Halteres very slender at base, broadening rapidly to tip of first joint, and somewhat constricted at middle of this joint. Apical or hook joint nearly as long as basal joint. Two ocellar spots on lateral margins of head, immediately behind compound eyes. Thoracic details as shown in figure 15.

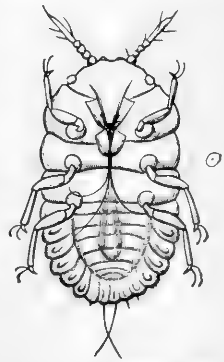

FIG. 16.—*Diaspis lanatus:* Young larva—greatly enlarged (original).

Newly-hatched Larva (Fig. 16).—Color dark orange. Eyes purple, legs and antennæ pale. Antennæ six-jointed. Joints 1 to 5 subequal in length and decreasing in width. Joint 6 long, acuminate, ending in a delicate stylus. Each segment of the abdomen bears on each side a rather strong lateral spine increasing in length towards anal end of body. Two long bristles at tip.

Female Larva, Second Stage (Fig. 17).—Color light orange yellow. Shape very broadly oval. Abdominal segments not incised and difficult to detect. Antennæ not increased in size and appearing almost rudimentary. Lateral bristles very short, scarcely distinguished; anal bristles also short. Surface of dorsum covered with dense, curly, glistening, white waxy threads. The pores from which

the threads are secreted are not evident. Eyes lighter in color than in preceding stage. Surface of skin delicately microscopically shagreened. Legs extremely short. Rostral filaments short.

Other stages not observed.

EXPERIMENTS WITH INSECTICIDES.

A series of careful tests was made with various standard insecticide mixtures to determine the best means of destroying the scales by winter treatment. The first of the series were with the substances which have proved most successful in California in the treatment of the Pernicious Scale (*Aspidiotus perniciosus*), which, in habit and difficulty of treatment, is not unlike this newly-imported one. The lime-sulphur-salt mixture and the winter resin wash were first experimented with, the latter being applied at the strength used in the California experiments, and also at double that strength. The applications were made January 31, 1894, the day being a clear and warm one, and the trees were liberally treated, so that they were thoroughly wetted. The weather continued warm after the applications, and occasional light rains fell. Examination on February 6 showed that so far no injury whatever had resulted to the scales. The rains had not been sufficient to wash from the trees the lime which adhered from the lime-sulphur-salt treatment. On March 7 the lime sulphur-salt treatment still indicated no results in the destruction of the scales. The resin wash at the standard strength had resulted in the death of about 20 per cent of the scales; at double the standard strength, in the death of about 50 per cent. Examined April 2, the ratio of injury in the case of the resin wash applications had not changed. A very few dead scales were found on the trees treated with the lime-sulphur-salt wash—perhaps about 5 per cent.

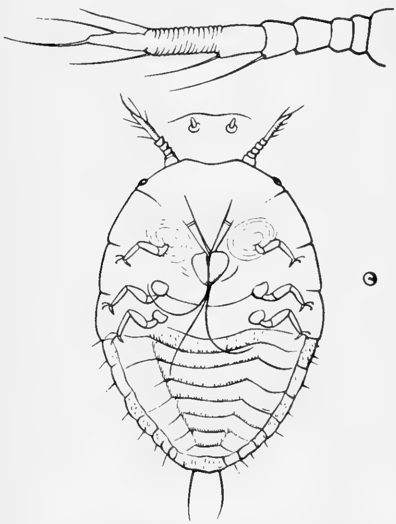

FIG. 17—*Diaspis lanatus:* Half-grown female, enlarged, with frontal tubercles and greatly enlarged antenna above (original).

The later series of experiments on a new lot of trees was made with kerosene mixtures. Kerosene emulsion made with whale-oil soap and diluted five times, the same diluted two and one-half times, and pure kerosene were used. These applications were made March 10, and the trees were again thoroughly wetted with the insecticides. Examination March 15 failed to show any evidence of injury to the scale in the case of the diluted kerosene emulsion. A tree to which pure kerosene

emulsion was applied presented insects which were not certainly dead, but had changed color, assuming a duller tint and losing the normal bright, glistening yellow of the healthy individual. The same effect, but to a much less degree, was noted in the case of the tree to which pure kerosene oil was applied. Examined March 20, no certainly dead insects were noticeable in the treatment with diluted emulsion, but with the pure emulsion all were dead and rapidly drying up and turning black. Upon the tree treated with pure kerosene emulsion the scales were nearly all in the same condition, perhaps 10 er cent. showing evident signs of life. Examined April 2, kerosene emulsion five times diluted did not appear to have killed a single insect. Diluted two and one-half times, 10 per cent. had succumbed; the rest were apparently uninjured. The pure emulsion had resulted in the destruction of every individual; they were all dried up, flattened, and of a black color. Pure kerosene had resulted in a precisely similar outcome. A certain yellowing of the inner bark of the trees in the case of the last two applications would seem to indicate that some injury was done to the tree, although this may have been due to the injury resulting to the tree from the unusual abundance of the scale itself. All the trees treated have bloomed abundantly, and are now (April 10) coming out in leaf; they appear to be nearly as thrifty as untreated trees similarly infested.

It will be seen from the above that this scale is a most difficult one to treat successfully during the dormant winter period; that it withstands with very little injurious effect the treatment with winter washes which have been measurably successful against the San José Scale in California; and that even double strength of the winter resin wash fails in practical results, since at least 50 per cent of the scales were not injured. A very strong application of kerosene emulsion diluted five and two and one-half times, each applied during the growing season, would certainly result in the death of the trees and fail also to kill any large percentage of the scales. The pure kerosene emulsion, which, on account of its thickness, adhered to the bark with considerable persistence, and the pure oil, were the only applications which were at all satisfactory, and it yet remains to be developed whether the trees themselves have been injured by these applications. We can therefore have very little hope of success from winter treatment unless in the way of pure kerosene oil or pure kerosene emulsion, if it should prove that these are not seriously injurious to the trees; and it will undoubtedly be necessary to treat the scale either by a system of extermination, uprooting and burning the trees, or by treatment with summer washes at the time the young hatch and begin crawling about in an unprotected state over the trees. At this period the ordinary ten-times-diluted kerosene emulsion or any of the standard caustic insecticides, summer resin wash, etc., would undoubtedly result in the destruction of the insect.

THE CURRANT STEM-GIRDLER.

(*Phyllœcus* [*Janus*] *flaviventris* Fitch.)

By C. L. Marlatt.

This interesting saw-fly has again been brought to notice in Dr. Lintner's recently issued Eighth Report as New York State Entomologist (pp. 166–168). It will be remembered that Dr. Lintner, in his Fourth Report, described the girdling of the tips of Currant stems by an unknown Hymenopterous insect in the gardens near Albany, N. Y. (4th Report on the Insects of New York, p. 47), and that later (Insect Life, Vol. iii, 1891, p. 407) was published, in Extracts from Correspondence, a communication from Mr. E. W. Allis, Adrian, Mich., with which he transmitted for identification an insect reared from Currant bushes affected as described by Dr. Lintner. No difficulty was expe-

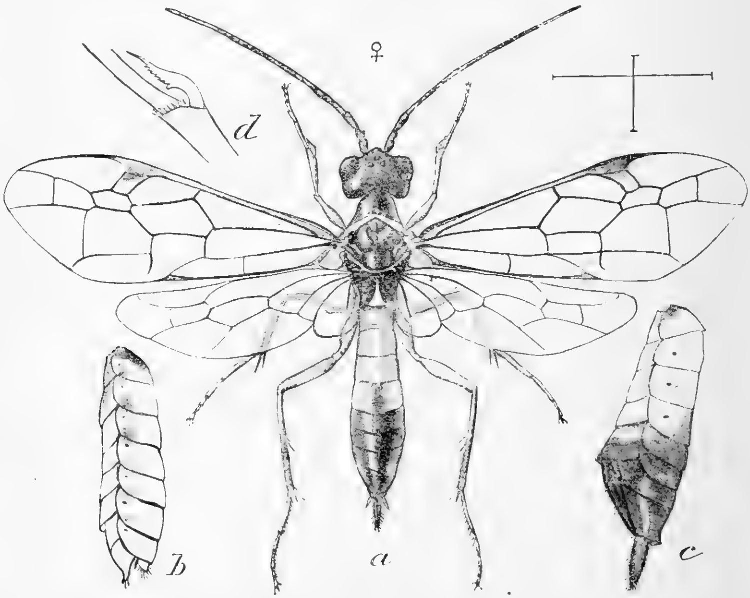

Fig. 18.—*Phyllœcus flaviventris* Fitch: *a*, female; *b*, lateral view of male abdomen; *c*, do. of female; *d*, apex of anterior tibia of female, showing serrated tibial spine—all enlarged (original).

rienced in identifying this insect as a male of Dr. Fitch's *Janus flaviventris*, which he described in his Seventh Report from a captured specimen. In April, 1891, Mr. Allis submitted personally an affected twig of the Currant containing a dried larva, and bred males and females of this insect, donating a specimen of each of the latter to the Department. From these the accompanying illustration was made (Fig. 18). A single specimen was reared by Dr. Lintner, as reported in his last communication, but was mislaid before a careful comparison with Fitch's description was made, but was thought not to be the same

species. This may be readily explained by his probably having a female which differs in shape, size, and coloration very markedly from the male, as will be shown later. The importance of this saw-fly as a serious currant pest warrants the collating of the fragmentary facts in its life-history, as discovered by Dr. Lintner and his correspondents, and by Mr. Allis, and introducing careful descriptions, with figures of both sexes, to facilitate its ready recognition by fruit-growers.

The damage to the Currant, which was first noticed by Prof. C. H. Peck, New York State Botanist, in his garden near Albany, and afterwards by Dr. Lintner in gardens in Albany, was described by Dr. Lintner in his first article as follows:

A short distance below one of the larger leaves of a tip, five or six somewhat sharp curved cuts could be seen encircling the stalk, and from their depth nearly severing it, causing the tip to fall over and hang suspended by only some small point of attachment. In some instances where, from the dried condition of the end of the stalk, it was probable that the cutting had been done a few days previously, the tip had broken off and fallen to the ground.

It was at this time supposed that the egg of the parent insect was deposited in the severed tip, and indeed in a single instance a newly-hatched larva was found very near the point of excision—its occurrence here, as will appear later, being doubtless accidental. Previously, and during the time covered by these observations in New York, Mr. Allis succeeded independently in rearing numbers of both sexes of the parent fly from Currant stems, in his garden near Adrian, Mich. In transmitting his first specimen he wrote:

I send you by this mail one male parent of a native Hymenopterous currant-worm, the same as was noted a year or two ago by Prof. Lintner in his New York report. I first bred one pair in 1887 from larvæ grown in 1886, and this was raised in 1888–'89. The springs of 1888 and 1890 I was not able to find any. Please report name, and so forth.

In conversation at the time of his visit to Washington in 1891, he described the nature of the work substantially as is given in the Eighth New York Report, by a later correspondent of Dr. Lintner, Mr. J. F. Rose, of South Byron, N. Y. Mr. Rose writes under date of June 6, 1891, as follows:

I inclose specimens of a few currant stems which show the work of an insect which cuts them off so that about two or three inches of the young growth breaks over. A few years ago I was badly tormented with currant borers, and on marking several shoots in June that were injured in this way, I found that each of them in the spring had a borer. Since that time it has been my habit to go over the currants several times, cutting off these shoots one inch below the injury and burning the injured tips. I now find very few borers. Am I right in thinking that the saw-fly, or whatever it is that does the cutting, is the egg-inserter that makes the Currant Stalk-borer?

Two of the twigs sent by Mr. Rose were dissected by Dr. Lintner, and the egg was discovered within the stem about one-half an inch below the punctures. It is described as white, transparent, rounded at the ends, one-twentieth of an inch in length and half as broad.

From these records and the knowledge of allied species, I am enabled to present the following summary of the life-round of this insect. The parent fly makes a number of cuts about the twig of the Currant, two or three inches from the tip, girdling it and causing the tip to wither, die, and commonly break off, and deposits a single egg just below the cut. In the exceptional case noted above, of the egg being deposited in the severed portion, we have a case of mistaken instinct on the part of the female, either in depositing the egg above the cut or in cutting below the egg instead of above it, if the egg deposition is the preliminary step. The object of the girdling of the twig becomes apparent from a knowledge of the habits of European species and the other American species whose habits are known, and it is undoubtedly to cause a cessation of growth and the dying and drying condition of wood and pith, which best suits the needs of the developing larva. The young larva works slowly down the center of the twig, feeding on the pith and surrounding woody portion of the stem, becoming full-grown by autumn and spinning a delicate glistening silken cocoon near the base of the burrow in which it winters as larva. The transformation to pupa and adult does not take place until early in May of the ensuing year, the mature insect then cutting its way out by means of its large and powerful mandibles. The specimens which we have from Mr. Allis emerged early in May, and the injury to the tips of twigs indicates that in New York also the adults are flying during this month.

The very simple and easy remedy practiced by Mr. Rose is the best that can be suggested, and with thoroughness in its application will insure immunity from the borer. It will be advisable, however, to cut off the injured shoots at least two inches below the girdle rather than one, as the egg in some instances may have been deposited lower down, or the larva may have hatched and begun its downward course.

The fact that this insect attacks a cultivated plant led to the suspicion that it might be of foreign origin, since it would not be at all difficult to import its larva in currant bushes; but, although there are several closely allied European species having similar habits, none of these come anywhere near *flaviventris* in specific characters. The cultivation of the Currant in south Europe dates back but a few centuries, although it is a native of the north and temperate latitudes of both Europe, Asia and America. It is more than likely, therefore, in view of the abundance of the wild Currant throughout the northern half of this continent, and the absence or nondiscovery of the insect in Europe, that this currant-borer is limited for the present to the North American continent, having in later years transferred its attention from the wild species to the cultivated varieties.

Of the allied European species *P. femoratus* breeds in the lower twigs of the Oak, causing a spindle-shaped enlargement, often exteriorly covered with minute, knob-like elevations, the injured portion

usually slowly dying and drying up. The course of the larval existence is the same as outlined for the currant species, and the perfect insect emerges about the last of April. Another species, *P. compressus*, breeds in pear twigs which wither and die in a manner quite similar to affected currant twigs, the transformations and habits being identical with the currant species. Another species, *P. fumipennis*, affects the Blackberry, a fourth, *P. phtisicus* the Rose, and a fifth, *P. xanthostoma* the Spiræa; while the habits of still other species have not been discovered. These species are mentioned for the reason that any of them, and particularly the last three, are liable to be imported with the plants they infest, and may be either already present in this country or likely to appear at any time.

A closely allied American species, *P. integer* Norton, affects the Willow in exactly the same manner that the currant injury is done, even to the girdling of the twigs to prevent their further growth, the portion beyond the cut drying and eventually dropping off. The girdling is done in the case of this species, and possibly also with the currant insect, by the ovipositor, and is about one inch above the point where the egg is inserted. The female is remarkably similar to the same sex of *flaviventris*, and would, unless carefully examined, be easily mistaken for the latter. It is distinguished, however, by the absence of the sooty spot extending from the stigma, and the first and second abdominal segments usually, and rarely the third in part are yellow. The male of *integer* is easily distinguished by its black or brownish-black abdomen. A full account of this species, with figures is given in volume I of INSECT LIFE (pp. 8–11).

One other American species, *P. trimaculatus* Say, is recorded by Prof. J. B. Smith as infesting the blackberry and raspberry canes. (Rept. Entom. Dept, N. J. Agri. College Expr. Station, 1892, p. 464.)

The subfamily Cephidæ (or tribe *Cephini* Konow) belongs properly to the family Uroceridæ (subfamily *Siricetæ* Konow), which includes the wood-boring Hymenoptera. The Cephidæ have been separated into three genera: Cephus, Phyllœcus and Janus, of which the last is chiefly distinguished from Phyllœcus by a sexual character, viz, whether abdomen is cylindrical or compressed, the former condition being the normal one for the male and the latter for the female. Janus has therefore been generally dropped by later European writers, and in fact both André and Cameron group all the species of Cephidæ together, the former indicating the groups belonging respectively to Cephus and Phyllœcus only in his list of species, describing them all in his monograph under Cephus; and the latter using the three genera merely to group allied species in in the genus Cephus. Konow, however, gives, and rightly in my judgment, full generic value to Phyllœcus. These two genera are separated by the following characters: Cephus, antenna thickened toward the tip; claws with small subapical tooth; Phyllœcus, antenna filiform or tapering toward the tip, claws

forked or cleft at apex. Fitch's single male specimen was quite naturally referred by him to the genus Janus, as formerly understood, and what is unquestionably his veritable type specimen, I was fortunate enough to discover in a badly damaged condition, but still recognizable, among the Tenthredinidæ of the Fitch collection now in the National Museum, enabling me to remove any doubt as to the identity of the species reared by Mr. Allis with *flaviventris*. Since the discovery by Fitch of this specimen, no other examples of this species have come into the hands of entomologists, until the rearings of Mr. Allis, neither Cresson nor Norton having seen the insect. Fitch's description is as follows:

It is a pretty little fly of a shining black color, with the hind body lemon yellow, except at its base, its mouth being straw-colored, and also the hind margin of its collar, the base of its wings, a small spot above their sockets, and the fore and hind margins of the metathorax. The hind body is narrower than the fore body and more narrow and long than in the typical species of this genus, forming almost two-thirds of the total length of the insect. Its basal segment is black, edged anteriorly with straw-yellow, and with a slender line of this color along its middle, ending in a large triangular spot. The second segment is also black, except at its hind end; and on the sides is a blackish cloud on the sutures of each of the remaining segments. The wings are hyaline and glassy, their stigma sooty brown, which color extends inward, occupying most of the anterior marginal cell. A faint smoky cloud may also be perceived near the middle of the posterior apical cell, and another along the margin of the anterior one. The hind feet are dusky.

This species he called the Yellow-bellied Janus, placing it thus, because, as he says, the hind body is cylindrical instead of being compressed.

DESCRIPTION.

I append a more careful description of both sexes, the female being characterized now for the first time.

Female.—Length, 12mm; wing-expanse, 20mm; antennae, 28-jointed; general surface body, glistening; head, large, quadrate, black, palpi and mandibles, yellow, except reddish-brown tip of the latter, which are also very broad and tridentate, the upper tooth longest and middle smallest; thorax black, with hind margin of prothorax, tegulae, spot above base of anterior wings, narrow posterior borders of scutellum and post-scutellum of mesothorax, cenchri, large triangular opening in metathorax, and area beneath the base of posterior wings light lemon-yellow; wing-veins in general brown, costal vein yellow, stigma brown, yellow at either extremity, and with sooty patch extending down over one-half the first cubital cell; tips of wings very faintly infuscated; first cubital cell complete; abdomen, reddish-yellow and black; first segment with small lateral black spot at base, narrowly connected dorsally; second and third segments entirely yellow, fourth with black dorsal spot, balance black, including sheaths; venter of fifth segment somewhat paler; legs in general reddish-yellow, bases of coxae, black; basal one-eighth of tibia lemon-yellow, particularly noticeable in the posterior pair; upper tips of hind femora and outer three-fourths of hind tibiae and all of hind tarsi, dark brown.

Male.—Length, 9mm; wing-expanse 17mm; antennæ 25-jointed; markings and characters in general as in female, except that the legs are much lighter, the anterior pairs being in general pale lemon-yellow throughout, and the hind pair much lighter than in female. The wings are decidedly infuscated at outer margin,

particularly in the lower apical cells. The chief point of difference is in the abdomen, which is generally reddish-yellow; the first segment (second of Fitch's description, the basal plates of the metathorax having been inaccurately described as the first abdominal segment) is black, with yellow apical margin, and a more or less distinct dusky oval spot, growing fainter on the posterior segments, marks the sides of each of the following segments at the base.

HABITS OF STIBADIUM SPUMOSUM *GR.*

By Mary E. Murtfeldt, *Kirkwood, Mo.*

The Russian Sunflower, in which the disk is very large—not infrequently from five to six inches across—and consequently productive of many seeds, is already cultivated to considerable extent in parts of this country, as well as in eastern Europe and Asia, for the value of its seeds as food for horses and poultry. The seeds also yield a well-flavored and delicate oil, of which small quantities are manufactured for commercial purposes, and it is probable that plants of this and allied species will become, in the course of a few years, of considerable enconomic importance.

In view of this fact its insect enemies, of which there are a large number, are worthy of attention. Among these the species named above is prominent. It belongs to a small and peculiar group of Noctuids, of which but three species have been characterized, and, so far as I can learn, the immature stages of these insects have never been studied. A year ago last August I found a large proportion of the heads of the sunflowers infested with some insect which ejected its castings upon the surface of the flower, which, mingled with the withered florets, formed a dry, matted crust that in time became more or less moldy. Upon breaking open the injured disks one or more short, thick, and grub-like lepidopterous larvæ were disclosed. These had been feeding upon the achenia from the under side and forming cavities and channels in the spongy receptacle.

The full grown larvæ were about one inch in length by one-fourth inch in diameter, with very large golden brown head and broad corneous collar of a darker shade of the same color. Otherwise they were of an opaque cream white, in some cases with a slight dorsal rosy suffusion. Specimens sent to Washington were not recognized, and therefore a large number of infested flowers were placed in a rearing cage in the hope that they would complete their transformations so that the species could be ascertained.

When full grown the larvæ dropped from the flowers and burrowed into the earth to the depth of two or three inches, where they inclose themselves in broad, oval, thick, felt-like cocoons, which were outwardly encrusted and disguised with earth. Within these cocoons they soon changed to pupæ, in which form they remained for many

months, as the moths did not appear in the cage until late in August, although out of doors the young larvæ were already at work in the flowers. A specimen of the moth was inclosed to Dr. Riley and by him kindly determined as above.

During the past summer the sunflowers suffered still more than in the previous year, fully seventy-five per cent showing the work of the insect, while about half of those infested had almost every seed eaten. The dwarf varieties of sunflower were also attacked, but the preference of the insect is evidently for the large flowered sorts.

I watched in vain by moonlight and lamplight to see the process of oviposition, as well as to capture some of the moths, but was not able to discover any upon the flowers, and I infer that they are not on the wing until late at night. This conclusion is supported by the fact that among all the various Noctuids taken here at light or by sugaring during the past twenty years there was not a single specimen of this species.

DESCRIPTION.

I append a somewhat more exact description of the larva and pupa:

Young larvæ more slender in proportion than when full grown and usually more roseate in color.

Mature larva 25 ^{mm}. in length, diameter 6 to 7 ^{mm}.; nearly the same throughout; from cylindrical, surface much wrinkled, especially laterally; color opaque cream white with a tinge of rose or pale brown on the medio-dorsal region; piliferous plates pale but distinct, giving rise to short, fine, light hairs. Head golden brown, indistinctly mottled with a darker shade of the same color; trophi almost black with a white base, mandibles unusually strong; cervical collar corneous, polished, mahogany brown, broad and deep, entirely covering the upper surface of the first segment; anal plate small, elliptical, corneous golden brown. Legs brown; prolegs white with brown pads. Stigmata minute but black-rimmed and distinct.

Pupa short, thick with a glassy appearance, of a shaded brown color with tinge of green on thorax and abdomen.

The moth expands about one and one-half inches and the prevailing chocolate-brown color has, as Mr. Grote expresses it, a peculiar frosted appearance owing to the scales being more or less distinctly tipped with white. In the female the ovipositor is noticeably long and telescopic. The affinity of this insect to Gortyna is apparent to the most careless observer.

THE INSECT GUESTS OF THE FLORIDA LAND TORTOISE.

By Henry G. Hubbard, *Crescent City, Fla.*

The Florida Gopher, *Gopherus* (*Xerobates*) *polyphemus*, is a tortoise attaining ten or twelve inches in length and weighing eight or ten pounds. It excavates galleries 18 or 20 feet long in the sandy ridges remote from water. These galleries descend in a straight course at an angle of 35° and terminate abruptly, usually in a layer of indurated

subsoil, at a depth of eight or nine feet beneath the surface. Like its European relative, the gopher is a very long-lived animal. That it may live more than one hundred years I am inclined to believe is true. Certain it is that a quarter of a century brings little or no change to a full-grown tortoise, and the oldest inhabitant in Florida can not tell of the beginnings of some of their burrows. Such ancient and well-established domiciles, with entrances always invitingly open, naturally serve as places of refuge for many animals, when hard pressed by enemies, or to night prowlers when daylight overtakes them far from their proper homes. Even the rattlesnake, according to popular repute, has a more than passing acquaintance with these cool retreats.

A number of years ago I learned that the gopher has for a permanent guest, a sort of parlor boarder as it were, a batrachian, commonly called the gopher toad. Specimens of these I frequently saw on summer evenings sitting at the entrance of the burrows after the manner of toads, quietly waiting for their supper to come to them. On the slightest alarm these timid creatures leaped quickly back into the gopher hole and saved themselves, so that it was not until lately that I succeeded in capturing a specimen, and found to my surprise that the so-called toad was a veritable frog. The herpetologists of the National Museum, to whom I have recently forwarded specimens, pronounce it the very rare subspecies *Rana areolata æsopus* Cope. Indeed, only the type specimen existed in the Museum collection, and of its habits nothing was known.

The desire to know something more of the gopher and its associates led me finally to undertake the laborious task of excavating and thoroughly examining one of their burrows. Accordingly, in January, 1893, I selected one of the largest burrows near my winter home at Crescent City and proceeded to open and inspect its inner recesses. The excavation was in the loose yellow sand of our pine woods subsoil, and when my exploration was completed, so large a pit had been dug that a coach and span of horses might have been swallowed up in it.

I had not descended many feet along the course of the burrow when I found that the walls and particularly the roof of the gallery were alive with specimens of a wingless cricket of the genus Centhophilus.

I next caught a glimpse of a very diaphanous Staphylinid, but so agile was this beetle and so like in color to the surrounding sand that several specimens slipped in succession through my fingers and escaped me. In subsequent explorations I recaptured this insect, which proves to be a Philonthus hitherto undescribed and remarkable for its slenderness of stature, its lack of color, and the distinctly subterranean appearance which marks a true cave insect and dweller in darkness. As I approached the end of the burrow, the sand became fairly alive with larvæ and imagos of a small Aphodius, also a colorless species, very subterranean in appearance. This is likewise an undescribed member of its genus closely allied to, but distinct from, common forms now living in the dung of domestic animals.

At the extreme end of the tunnel I found the gopher, quiescent but not dormant and resting upon a thin layer of fibrous material, evidently the winter accumulation of its excreta, in which could be plainly discerned the coarser and undigested portions of the leaves and vegetation which formed its food. Beneath this layer the sand was mined in every direction with the burrows of coprophagous insects, and I soon had a considerable collection, including a Trichopteryx, a new Histerid allied to Saprinus with its larva, and finally a Copris, which, from its size and general appearance, I took without doubt to be the universally distributed *Copris minutus* of our barnyards. But upon comparison with the known forms of the genus this proves to be quite a new and distinct species.

Besides the main deposit of dung upon which the animal was resting I found several smaller deposits which had evidently been pressed aside and partly imbedded in the sand by the movements of the turtle. These were all centers of attraction for the dung-eating beetles, but I found lurking in one of the masses a number of lepidopterous larvæ an inch or so long. Their dusky-brown coloration so closely corresponded with the material in which they lay concealed that I would probably have overlooked them had not their lively antics, their wriggling and twisting when disturbed made them very conspicuous objects. My first suspicion that these caterpillars were coprophagous was afterwards confirmed, and I ascertained that they eat the fresh dung of the turtle in preference to that which has been overhauled by other insects.

Only three burrows were opened in January, and of these one alone was inhabited by the gopher. In the month of July following I examined a larger number of gopher burrows, and in all eight galleries were carefully and thoroughly explored. The midsummer explorations greatly increased the knowledge previously gained of the habits of the gopher insects and added several new forms to the list. As most of these insects are new to science, detailed descriptions of them will be found at the end of this paper.

The following is an enumeration of the insects found in the gopher burrows, with the habits of each as far as I have been able to observe them.

COLEOPTERA.

(1) *Homalota* sp.—A small blackish species which has not been identified with any of those in our collections occurs in considerable numbers in the terminal "nest" of the turtle. It is not at all a striking form, and belongs to a group of numerous and, for the most part, unstudied species, many of which live in dung. To name and describe it at this time would only add to the confusion already existing in this and other genera of North American Aleocharinæ.

(2) *Philonthus gopheri* n. sp. —Occurs sparingly in many burrows. The larva was not discovered, but it presumably feeds upon the other insects in the burrows.

(3) *Trichopteryx* n. sp.—A brown species allied to *T. ambigua* Matthews. Abundant in accumulations of old dung at the end of many of the burrows.

(4) *Chelyoxenus xerobatis* n. g. et. n. sp.—Very common, burrowing in the sand in all parts of the galleries. Its larva was also found among the coprephagous larvae in the dung, and I have reason to believe that it is carnivorous but not predatory, *i.e.*, it feeds only upon the dead or dying insects.

(5) *Saprinus ferrugineus* Marseul.—A single very small specimen of this common Floridian species was found in a gopher hole on July 15. This is the only one of the Coleoptera found associated with the gopher, which also occurs above ground.

(6) *Copris gopheri* n. sp.—Specimens were found in every gopher hole examined, and were frequently abundant. Eighty-four specimens were collected in a single burrow. The female forms food-balls of gopher dung, after the manner of related species above ground. In each of these she lays a single egg, and then buries it 4 or 5 inches deep in the sand beneath the floor of the gallery. The material in these balls is finely fibrous and dark green in color. The larva begins eating near the surface of the ball and forms a cavity considerably larger than its body by pressing outward the dung, thus disturbing the sphere and rendering it more or less pear-shaped. In this operation it is evidently assisted by the peculiar hump on the back, so remarkably characteristic of the larvæ of this genus. The larva does not consume the whole of its food supply, but disintegrates the greater part of the mass, converting it into a friable, black earth which falls away at a touch. It finally constructs an oval cocoon within the ball, with rather thin and brittle walls formed from this black earth, cemented by saliva or some other secretion, and in this completes its transformations. In the burrows which contain egg-balls, specimens of the imago are less common, and there appears to be a continuous succession of broods throughout the year.

(7) *Onthophagus polyphemi* n. sp.—I did not find this beetle in the few galleries examined in winter, and it was probably in pupa at that season. In July it was not rare. One of the burrows produced twenty-one specimens. Its larva was not seen.

(8) *Aphodius troglodytes* n. sp.—This is the commonest of all the gopher insects. It swarms by hundreds in many burrows and is present in all of them. Young in all stages are found at all times in the deposits of dung which are rapidly disintegrated by them. The extremely pellucid and diaphanous integument of the imago in life, permitting every vein and fold of the wings to be plainly seen through the elytra, can not be confounded with the appearance of other pale species of the genus found above ground, and indicates a subterranean mode of life. This habit is also shown in the active but aimlessly wandering movements of the beetle and its evident distress when exposed to the light.*

LEPIDOPTERA.

(9) *Deltoid* (?) *moth.*—A sooty-brown caterpillar about an inch long, which occurs rather sparingly in most of the gopher burrows and feeds upon the dung, is perhaps the most interesting of the scavengers connected with the tortoise. Its body is naked, but with many transverse folds, and each segment bears a double row of tubercles, surmouted by stout, truncate spines. The thorax is marked with a narrow chitinous shield. The prolegs are armed with a bundle of hooked hairs, by means of which it easily climbs the walls and roof of the gallery, clinging to a few strands of invisibly fine web thrown over the loose sand.

In all probability this caterpillar is the larva of an undescribed Deltoid moth. It is well known that the feeding habits of some members of this family differ from those of other lepidoptera. The larvæ of at least two species of Helia are myrmecophilous, feeding no doubt upon the dead vegetable substances gathered by the

* *Anthicus ictericus* Laf. A single specimen of this beetle, which is common in the surface sand in Florida, was found in excavating one of the burrows among the gopher insects. Its presence was no doubt accidental.

ants. Other deltoids are known to feed upon dry leaves, but no lepidopterous larva has ever been observed to live upon the excrements of any animal.

The larvæ taken in January were full grown and were evidently hibernating. Two specimens formed naked pupæ, which were finally destroyed by mold, and I failed to breed the moth. In July the larvæ found were young, and proved to be exceedingly delicate and difficult to rear. Most of the specimens immediately died when taken from the cool retreat of the gopher and exposed to the light and heat of the sun. By taking extraordinary precautions I at last succeeded in domiciling two specimens in a tightly closed Mason jar, partly filled with moist sand taken with them from the gopher hole. I supplied these caterpillars with fresh dung from a gopher kept in confinement. They fed upon this at night, or when the jar was darkened by a thick covering. When captured (July 18) they were about one-third grown. In three weeks they consumed or disintegrated about three cubic inches of the dung placed from time to time in the jar, and nearly doubled in size. In August they were taken North to Detroit, Mich., where they soon began to hibernate and stopped feeding. Both subsequently died without pupating.

ORTHOPTERA.

(10) *Ceuthophilus latibuli* Scudder, n. sp.—This wingless cricket is found in all stages of growth and in great numbers in every burrow. They crawl readily along the sides and roof of the gallery, waving their long antennæ and behaving in much the same manner as their relatives in the caves.

CHERNETIDÆ.

(11) *Chelanops affinis* Banks, n. sp.—Five or six specimens of a pseudoscorpion were taken in the débris at the end of the galleries. One was collected in January; the remainder in July.

IXODIDÆ.

(12) *Ornithodorus americanus* Marx, MS.—The young of this tick infested one of the burrows opened in July. They were full of the blood of the turtle, but had not attached themselves to the body of the animal, and I conclude that they do not do so until they become adult. The mature ticks are sometimes found upon the gopher, adhering to the leathery skin behind the legs, after the manner of ticks generally. The young ticks of all sizes, to the number of twenty or more, were found in the terminal débris, and scattered along the gallery half way to its mouth. The species has been found in Texas in the nostrils of horses, and upon the llama in South America.

(13) *Amblyomma tuberculatum* Marx, n. sp.—A single specimen of this large and handsome tick was found attached to one of the sutures of the under shell of a large gopher, with its beak firmly inserted in the ligaments. I have no further knowledge of its habits. *

This interesting association of messmates and parasites of the gopher tortoise forms a distinctly subterranean fauna, in which the genesis of true cave life is very instructively shown. The differentiation of the various forms from their allies above ground has, it is true, not pro-

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* *Thelyphonus giganteus* Lucas.—A very large specimen of the Whip-tailed Scorpion was found in a small gallery of its own, connecting with that of the gopher at a point about six feet beneath the surface of the ground. It is merely an intruder, and probably feeds upon the crickets.

A flea found in one of the burrows was probably left behind by some mammal that had visited the gopher hole.

ceeded so far as to produce profound modifications of structure, and only in a single instance the erection of a new genus was deemed advisable. The absence of eyes and the substitution of sensitive bristles as delicate tactile organs to compensate the loss of sight in cave insects, are results of a life in total darkness. In the twilight and incomplete isolation of the gopher burrows so radical a change is not likely to be effected. Nevertheless the variation that has been produced by this half cave life is sufficiently pronounced. It is shown in many of the species by a loss of color, a general tendency to suppression of punctures and protuberances, a more glabrous surface of the body, and greater slenderness of form than is found in related species.

The origin of some of the Coleoptera, at least, is plainly indicated by their close relationship with forms living outside of the burrows. Thus *Copris gopheri* may have been derived from *C. minutus*, with which it agrees closely in size and shape, as well as in general structure. *Aphodius troglodytes* is also very nearly related to *A. stercorosus*, which inhabits the same region. Both the Copris and the Aphodius differ from their congeners notably in smoothness of surface and general tendency to obliteration of sculpture. The differentiation in each case is such as may be supposed to have been brought about by a life under ground. The chitinous integument in both these beetles shows some change. In the Copris it matures very slowly and frequently fails to attain the normal black color. The Aphodius, although belonging to a group of light-colored species, is by far the most thinly chitinized form in the genus, and in life is as colorless as an Anophthalmus. The eyes, too, are smaller and the legs more slender than is usual among its allies. In *Onthophagus polyphemi*, likewise, important distinguishing characters are found in its narrow eyes, its polished, glabrous surface, and the absence of protuberances and of punctures upon the thorax, especially in the male, which seems to differ more than the female from the type of Onthophagus common in our fauna. It is not related to any of our species, and appears to belong to a different group. It may be allied to some species in the West Indian fauna with which I am not familiar. The Staphylinid, *Philonthus gopheri*, is another insect which can not be affiliated with any other species of the genus. It is structurally allied to *P. longicornis* and one or two other black forms, but these belong to the circumpolar fauna and are not known to occur in Florida. Our present system of classification does not necessarily indicate natural relationship in the Philonthi, and can not be said to give the true affinities of this species. Its lack of color shows it to be a subterranean form, it is also remarkably slender and feebly punctate, and has slender legs and unusually long, fine claws.

Especially noteworthy in respect to its affinities is the new Histerid, *Chelyoxenus xerobatis*. This species, although structurally closely related to the genus Saprinus, present a character which is not paralleled in

any other Histerid genus in our fauna, while at the same time its resemblance to a Hister is quite remarkable. I believe it to be an ancient form, not modified by its underground life, but preserved from extinction by its isolation or the favorable conditions of its environment.

In the foregoing study of the Coleoptera, which are closely connected with the economy of the gopher and have probably been long associated with it as scavengers, there will be found reasons for believing that this assemblage includes not only species differentiated from forms substantially the same as those now existing on the surface, but others, extinct outside the burrows, which have survived because of their environment and may not have been modified by it.

That a gallery in the sand of such diminutive proportions as a gopher's burrow can harbor such a large number of hitherto undiscovered insects, and afford an environment potent to effect such changes in the structure and life of animals, might well seem incredible, were it not for the very unique conditions which here exist. The moisture of the subsoil does not vary. The temperature of the burrows varies but five degrees throughout the year; the extreme in winter being 74° F., and in summer 79° F. The tortoise is a reptile of ancient lineage, whose burrowing habits were probably established in ages zoologically remote. It is a long-lived animal, and its habitation once completed is maintained and occupied for a very long series of years.

DESCRIPTIONS OF NEW SPECIES.

Philonthus gopheri n. sp.

Form slender, parallel. Color reddish-testaceous, shining, pubescence golden, head with a dark band behind the eyes. Head as wide as the thorax, longer than wide, widest across the eyes, with a few coarse punctures behind the eyes. Antennæ slender, as long as the head and thorax combined, all the joints longer than wide. Thorax slightly longer than wide, not narrowed in front, sides straight, slightly sinuate, punctures of the dorsal series four in number, moderately coarse, the posterior more distant. Elytra conjointly rather longer than wide, slightly longer and wider than the thorax, moderately densely, but not coarsely punctate, sparsely pubescent. Abdomen finely, rather densely punctured, punctures beneath rather coarser and sparser. Tarsi of hind legs long and slender, the claws very fine and long.

Male.—Front tarsi moderately dilated. Last ventral segment with a wide and deep triangular emargination, surrounded by a narrow gutter which does not extend forward at middle.

Female.—Head as large as in the male. Front tarsi much less dilated. Last ventral segment simple.

Length 5.6 mm.

Described from eight specimens, Crescent City, Fla.

Related to *P. varians* and *P. longicornis*, but distinguished by its slender form, pale color, larger head, by the form of the thorax, which is not narrowed in front, and the deeper emargination of the last ventral segment in the male. The antennæ are longer and more slender, the elytra less densely punctured and the tarsi much longer than in *P. varians*. It does not have the muricate punctuation of the elytra seen in *P. longicornis*; the latter is also somewhat larger. The eyes are rounder

and more protuberant in *P. gopheri* and are placed lower down on the sides of the head, so that they can be seen from beneath; in both the related species the eyes are flat, more elongate and are not visible from beneath.

From *P. discoideus* it is readily distinguished by the long antennæ and the sexual characters of the male. As is the case with *Aphodius troglodytes* this insect turns darker after death. In life its color is pale yellow like the sand in which it lives.

Chelyoxenus n. g.

Head retracted; antennæ inserted under margin of the front; prosternum not lobed anteriorly, convex, bistriate; antennal fossæ immediately in front of the anterior coxæ; mesosternum truncate anteriorly; elytra with five dorsal striæ, the four outer ones nearly entire, the fifth abbreviated and usually appendiculated at apex; pygidium triangular, convex, greatly and rather suddenly inflexed apically; femora not incrassated; front tibiæ dilated and multi-dentate; middle and hind tibiæ slender, biseriately spinose; tarsi of middle and hind legs slender; claws strikingly unequal in length: the inner one very slender and almost as long as the claw joint, the outer one spine-like and only about one-fourth the length of the inner claw.

This new genus of Histeridæ is proposed for a rather small species which agrees with Saprinus in all essential characters excepting the structure of the tarsal claws. Uni-unguiculated genera of Histeridæ are known both in the Histrini (Cypturus and Monoplius) and Saprini (Xiphonotus), but I am not aware that a genus has been described exhibiting a marked inequality of the claws. Superficially, this genus may be distinguished from Saprinus by the more complete elytral striation and also by the somewhat less ovate and less convex form of the body.

Chelyoxenus xerobatis n. sp.

Oval, shining, black, without metallic reflections. Head sparsely, minutely punctulate, front not margined, supra-orbital stria distinct, extending a short distance upon the front. Thorax fully twice as wide as long, sides convergent anteriorly and nearly straight from the base to apical fourth, thence arched; a single marginal stria; very finely and sparsely punctulate on the disk, more coarsely and densely on the sides. Elytra at apex finely, sparsely and rather irregularly punctate, the punctures extending slightly between the striæ, the remainder of the elytral surface very minutely and sparsely punctulate; a single very long subhumeral stria usually but slightly abbreviated at either extremity, sometimes interrupted or obsolete anteriorly; oblique humeral stria long, distinctly impressed; dorsal striae 1 to 4 subequal in length, extending from the base nearly to the apex of the elytra, deeply impressed and obsoletely punctured, not hooked at base, fourth arched at base, joining the sutural stria, which is strongly impressed and entire; between the fourth dorsal and the sutural a strongly impressed fifth stria of varying length, beginning sharply a short distance below the arch, frequently interrupted and continued by punctures at the apical end, where it is accom-

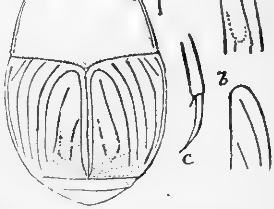

FIG. 19.—*Chelyoxenus xerobatis: a, b,* variations in elytral sculpture; *c,* claw of left hind leg—enlarged (original).

panied by a hook; the hook consisting of punctures which often become confluent, extending obliquely forwards toward the sutural stria and forming a short but distinct sixth dorsal stria; apical line feeble at the suture. Epipleuræ smooth, without striæ. Prosternum strongly convex but not carinate, nearly smooth; striæ entire, diverging, ascending, becoming horizontal and entering a deep but narrow fovea, thence converging and uniting on the anterior margin of the prosternum. Propygidium and pygidium with rather dense, shallow punctures, the latter without marginal groove and on the inflexed, apical portion with a smooth median line which, in some specimens, is slightly elevated. Mesosternum finely punctate. Metasternum nearly smooth at middle, coarsely punctate behind and on the sides. Front tibiæ with six or seven stout teeth, each armed with a spine; middle and hind tibiæ biseriately spinulose; the hind tiba at apex as wide as in the middle.

Length 3 to 3.8mm.

Numerous specimens taken from gopher holes, Crescent City, Fla.

The curious apical hook which accompanies the fifth dorsal is very variable and often obsolete or represented by a line of scattered punctures. In many specimens the curve of the hook is obliterated, the remaining portion appearing as a stria supplementary to the fifth dorsal. When strongly impressed and complete it is seen to be disconnected from the fifth stria as is shown at *a* in the accompanying outline sketch. (Fig. 19.)

The complete striation together with the smoothness of the elytra give to this species the appearance of a Hister rather than a Saprinus.

I am greatly indebted to Dr. George H. Horn for having my attention called to the peculiar structure of the tarsal claws, and it is by his advice that a new genus has been established upon this species.

Copris gopheri n. sp.

Oblong-oval, black, shining. Head and thorax sparsely and finely punctulate. Clypeus acutely not deeply emarginate, feebly sinuate on either side of the notch. Genæ rectangular. Thorax declivous in front and without prominences. Elytral striæ shallow, obsoletely punctured, interspaces smooth.

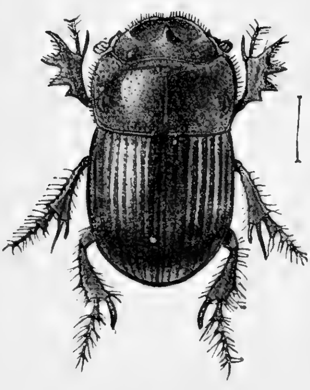

FIG. 20.—*Copris gopheri* n. sp.—enlarged (original).

Color black, varying to chestnut brown, many specimens failing to reach full maturity of the chitine. Surface highly polished, shining. Head minutely punctured, larger obsolete punctures occurring around the margin; clypeal emargination acute, moderately deep, the dentation on either side indicated by feeble sinuations; horn of the vertex stouter than in *C. minutus* and having upon its posterior margin a minute protuberance; in a few specimens the horn is reduced to an acute tubercle. Eyes above narrow, about twice as long as wide. Thorax with the declivity in front moderately abrupt, not vertical, without protuberance in either sex, at most slightly sinuate on each side; upper surface sparsely and obsoletely punctulate with denser and deeper punctures at the anterior angles; sublateral impression rounded, moderately deep; median channel more or less obsolete. Elytra with eight rather fine striæ; the eighth stria extending from near the humerus to the middle of the elytra, indistinctly punctured, the other striæ distinctly punctured,

except at apex; interspaces very slightly convex and entirely smooth. Undersurface smooth on the disk, punctured on the sides. Legs and tibial spurs as in *C. minutus,* the tooth on the outer margin of hind tibia smaller.

Length 7.5 to 10^{mm}.

Described from many specimens found in gopher holes at Cresent City, Fla.

At once distinguished from all our species by the brilliant polish and minute, inconspicuous punctuation of the upper surface. In size and shape and in the armature of the head and legs, as well as in the form of the tibial spurs, it agrees with *C. minutus,* from which it differs in the suppression of the punctuation, the feebly indicated, often obsolete clypeal teeth, the smaller and narrower eyes and the absence in both sexes of thoracic prominences. The elytral interspaces are less convex, and the eighth elytral stria is greatly abbreviated.

C. gopheri appears to have differentiated from *C. minutus* in comparatively recent times, and has attained a degree of divergence which in this group is universally recognized as having specific value. The large series of specimens from a single locality, Crescent City, Fla., do not show any tendency to variation, and unless intermediate forms occur elsewhere, the two species must be considered distinct.

Onthophagus polyphemi n. sp.

Oval, shining, black, antennæ, trophi and legs piceus; head, elytra, and part of thorax with sparse, long, erect, reddish hairs arising from the punctures. Head coarsely and sparsely punctate. Clypeus semicircular, somewhat truncate in front, not sinuate or dentate on the sides; margin reflexed; clypeal carina arcuate, vertical carina varying according to sex. Eyes above narrow, three times as long as wide. Thorax in form, sculpture, and pubescence varying in the sexes, wider than the elytra; sides seen from above scarcely rounded; anterior angles not acute. Elytra with seven finely punctulate striæ, the seventh stria arcuate, ending abruptly at a smooth humeral callus; interspaces not convex, shining, biseriately punctate. Episternum of prosternum horizontal, slightly excavated anteriorly for the reception of the antennal club. Mesosternum smooth at middle, rather sparsely punctate on the sides. Front tibiæ quadridentate, the upper tooth small.

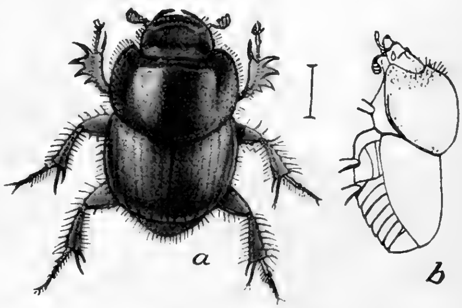

FIG. 21.—*Onthophagus polyphemi* n. sp.: *a*, ♂, from above; *b*, do., side view—enlarged (original).

Male: Vertical carina obsolete at middle, more or less tumid at the ends, sometimes reduced to a pair of feeble tubercles. Thorax strongly convex, much higher than the head, nearly vertical in front, crest of the declivity not protuberant but forming on each side a slightly elevated, obtuse ridge; surface of the thorax smooth and brilliantly polished, anterior angles and declivity, except at middle, densely punctate, sides sparsely punctate, the punctures extending some distance along the basal margin.

Female: Clypeus longer than in the male, less broadly truncate, vertical carina straight, entire. Thorax slightly convex, scarcely higher than the head, without declivity in front, surface strongly and unevenly punctate, the punctures on the disk much sparser and finer.

Length 5.5 to 6.7mm.

Described from numerous specimens found in July in gopher holes at Cresent City, Fla.

The sexual characters vary greatly in degree of development. For the above characterization of the sexes the most strongly marked specimens have been selected. In the large series before me there are individuals in which the sex can with difficulty be determined. The anterior tibiæ are equally stout in both sexes, but the distance between the front margin of the clypeus and the carina on its hind margin is always greater in the females than in the males and affords the best guide for the recognition of effeminate males.

In the male the vertical carina is sometimes nearly entire, the thorax is often less globose and in its form approaches that of the female. In such cases the anterior declivity disappears, and the punctuation extends more or less over the disk. The females vary less than the males, but the ends of the vertical carina are sometimes slightly tumid. The punctuation of the thorax is also variable and the disk is occasionally nearly smooth.

In addition to its peculiar sexual characters, the shining surface and sparse punctuation, even in the females, sufficiently distinguish this from all other North American species. All hitherto described species in our fauna have the pro-episternum excavated for the reception of the antennæ, the excavation beginning at the suture. In *O. polyphemi* this sclerite is very slightly excavate on its anterior face only, the greater portion of its surface being horizontal.

Aphodius troglodytes n. sp.

Belongs to group I-b of Dr. Horn's Monograph of the Aphodiini (Trans. Am. Ent. Soc., Vol. XIV, 1887.). Color, honey yellow, or reddish yellow. Head without ante-ocular impression, very sparsely and finely punctulate in both sexes, nearly smooth in front; eyes small, partly retracted into the thorax, finely granulate. Thorax finely punctulate, the punctures growing denser and somewhat larger on the sides, but without intermixed coarse punctures. Elytral interspaces with sparse, fine punctures, equally minute in both sexes. Hind legs and tarsi slender; the first tarsal joint longer than the three following joints; the two spurs nearly equal in length.

Length 3 to 3.8mm.

Very closely allied to *A. stercorosus*, but differs by the absence of an ante-ocular impression and by the character of the punctuation, which is always finer and does not vary in the sexes. The intermixed larger punctures upon the sides of the thorax are wanting in this species. The eyes appear less convex on account of the obliteration of the ante-ocular groove; they are usually in great part covered by the thorax and are appreciably smaller. The hind legs are more slender and the tarsi longer than in *A. stercorosus;* the first tarsal joint is always longer

than the longer spur, while in *A. stercorosus* the first tarsal joint is seldom longer, and in some females shorter than the spur.

The color in life is a transparent honey yellow, which becomes darker and turns red in seasoned cabinet specimens, but never exhibits any cloudiness upon the elytra. The head and thorax are never darker than the elytra.

Described from numerous specimens collected in gopher holes at Crescent City, Fla.

The species is evidently derived from *A. stercorosus*, which inhabits the same region, and it agrees so closely with this well-known species that a more detailed description is deemed unnecessary.

The table given by Dr. Horn in his monograph (*l. c.*, p. 34) may be extended to include the new species as follows:

Posterior tibiæ stout; first joint of posterior tarsus not as long as the next three; head with ante-ocular impression .... *rubeolus.*
Posterior tibiæ slender; first joint of posterior tarsus longer than the next three.
Head with ante-ocular impression; sides of thorax with large and small punctures intermixed .... *stercorosus.*
Head without ante-ocular impression; sides of thorax finely punctulate, without coarse punctures .... *troglodytes.*

Specimens of the Ceuthophilus were sent to Mr. S. H. Scudder, who has come to the conclusion that the species is undescribed. I have his permission to insert his description in this paper.

Ceuthophilus latibuli Scudder, sp. nov.

Dark brownish fuscous, heavily blotched with ferrugineo-testaceous, largely in the form of small longitudinally ovate spots more or less regularly disposed on the dorsum, but inclined to be confluent on the sides and forming blotches on the pronotum; the hind femora dark, with two series of longer and an intermediate series of shorter oblique testaceous lines; all the tarsi and at least the apical half of the tibiæ pallid luteous. Legs long and slender. Fore femora less than one-third longer than the pronotum, the inner carina armed with 2 to 4 longer or shorter spines on the distal half. Mid femora with 2 to 3 usually long spines besides a subapical spine on the anterior carina, and on the posterior carina a very long genicular spine, besides sometimes an additional spine. Hind femora about as long as the body, rather stout, but more than the distal fourth slender and subequal, the whole three (♂) to three and a half (♀) times longer than the greatest breadth; the outer carina slightly prominent, unarmed (♀) or furnished with 8 to 9 rather unequal, inequidistant short spines, the longest not half the length of the tibial spurs; inner carina with 6 to 8 inconspicuous (♀) or 13 to 16 small inequidistant (♂) spines, the intervening sulcus rather deep but of moderate breadth. Hind tibiæ much longer than the femora, straight, slightly compressed at the base, beneath with 1 to 2 preapical median spines besides the apical pair; spurs not opposite, the basal generally by or before the end of the proximal fourth of the tibia, nearly or quite twice as long as the tibial depth, set at an angle of about 60° with the tibia, and of about 120° more or less with each other, slightly incurved at tip; inner middle calcaria very slender, considerably longer than the first tarsal joint or than the outer middle calcaria and twice as long as the other calcaria or the spurs. Hind tarsi distinctly less than half as long as the tibiæ, the first joint not nearly equaling the rest together, the second and third together shorter than the fourth. Cerci slender, delicately tapering, about as long as the femoral breadth. Ovipositor straight,

rather slender, from a third to more than half as long as the hind tibiæ, the tip hardly upcurved and exceedingly acute, the denticulations of the inner valves triangular, hardly aculeate.

Length (single specimen measured) of body, ♂, 18mm, ♀, 17mm; antennæ, ♂, 55mm, ♀, 65mm (est.); pronotum, ♂, 5mm, ♀, 6mm; fore femora, ♂, 8mm, ♀, 8.5mm; hind femora, ♂ ♀, 18mm; hind tibiæ, ♂ ♀, 19.5mm; ovipositor, ♀, 10mm.

Described from 4 ♂, 5 ♀, besides 3 immature ♂.

Crescent City, Fla., in gopher burrows (H. G. Hubbard); Georgia (H. K. Morrison).—[Scudder]

The following description of the pseudoscorpion found in the gopher burrows has been kindly furnished by Mr. Nathan Banks.

Chelanops affinis Banks, n. sp.

Length 2mm. Pale yellowish, legs and abdomen whitish. Cephalothorax and abdomen with clavate hairs; those on palpi less clavate. Trochanters of palpi with globose projections above; femora slightly pedicellate, very little broader near base than at apex; tibiæ moderately swollen on inner side, slightly broader than femur and nearly as long; hand about as long as tibia and much broader, tapering to the fingers, the latter a trifle longer than hand, moderately curved. Abdomen quite broad, the segments indistinctly divided; legs more slender than usual.

Closely related to *Ch. pallidus* Banks, differing principally in the more swollen tibia, more slender and more pilose hand, and the longer legs.

Crescent City, Fla.—[Banks.]

To Dr. George Marx, of Washington, D. C., I am indebted for the following description of the tick found upon the Gopher.

Amblyomma tuberculatum Marx, n. sp.

Female: very large, suborbicular; length of body 7.6mm.; length of capitulum 3mm. Capitulum dark reddish-brown with a pale testaceous, narrow transverse band behind the front margin which extends in the middle, between the two glandular depressions into a round spot. Palpi reddish-brown with the basal part of the second joint pale testaceous, rostrum pale testaceous, shield dark reddish-brown with silvery figurations; abdomen of the same color, legs with narrow whitish tips of the joints. Underside: capitulum posterior region, reddish-brown, frontal one white, maxillæ yellow testaceous; palpi, first joint with a reddish-brown triangular sclerite; second joint with yellowish basal half and reddish-brown terminal half; third joint reddish-brown; coxæ dark brown; body brownish-yellow.

Capitulum longer than broad with rounded posterior and lateral margins without projecting postero-lateral angles, the glandular depressions oval, obliquely outward and deep. Palpi, first joint free, second joint with a long basal part, itself short and triangular, not quite double as long as wide, drawn out at inner basal angle into a point which, however, forms no projection, but runs into a ridge down to the first joint, underside at distal end projecting over the third joint; third joint as broad as long, basal margin with a sharp, short tubercular projection, maxillæ long, attenuate in the middle and with the tips clavate; armature, four rows of spinous plates on each side, occupying only one-fourth of the length, and the rest covered with flat, fish-scale-like plates which gradually diminish in size toward the base; mandibles as long as palpi, sheath with a furrow in the middle. Shield finely punctured, clypeus flat, sulci comma-shaped, very deep, a shallow impression behind them; abdomen without punctures, with distinct lateral groove and posterior lobes and three dorsal longitudinal lines behind the shield; underside, finely punctured, with short white hairs in the punctures; legs long and slender with sparse short white hairs; coxæ I with a short, round tubercle on the antero-internal region; the four coxæ with two flat and sharp tubercles obliquely above the posterior margin; at coxæ I the external

tubercle is narrower than the internal; in coxæ II both are of even width, and in coxæ III and IV the external one is broadest. Stigma, subtriangular, cancave with raised borders, external angle interrupted with a broad button-shaped lapel; peritreme flat, comma-shaped, straight, orifice oval.

Male: suborbicular; length of body 6^{mm}; length of capitulum 2^{mm}.

Capitulum of the same color as in female; dorsum reddish-brown with metallic (green and gold) supra-marginal band and some figurations of the same color over the surface, underside bright yellow; legs as in female.

Capitulum about as long as broad, with rounded posterior and lateral margins without projecting postero-lateral angles and without the ocelli-like impressions; maxillæ, palpi, as in female, dorsum uniformly and finely punctured with some single larger punctures in the posterior region; lateral groove absent, posterior lobes distinct, clypeus, underside and coxæ as in female. Stigma more subreni-form with a broad and long lapel on the external side. Coxæ I is provided also with a short round tubercle at the antero-internal region as in the female.

Described from two specimens from Florida, one of which was found upon the Gopher at Crescent City.—[MARX.]

My grateful acknowledgments are due to Mr. E. A. Schwarz, of Washington, for valuable assistance and suggestions in the preparation of this paper.

THE CONTROL OF PHYLLOXERA BY SUBMERSION.

We have from time to time referred in these pages to the results which have been obtained in Europe, and notably in France, in controlling the Phylloxera by flooding the vineyards at certain seasons of the year for definite periods, known as submergence, which has, of all the direct methods against this notable grape pest, proved most surely effective in its results, the sole objection to it being the expense attending it and the impossibility of applying it except in regions which are favorably situated. The submergence of vineyards for other than irrigation purposes did not originate with the invasion of the Phylloxera, for from time immemorial it has been the custom in south Russia and in Greece to inundate vineyards during winter to rid them of hibernating insects and snails. As a means against the Phylloxera it was first employed by Dr. Seigle, of Nimes, in July, 1868. A canal surrounding his property, leading from the River Durance, was taken advantage of to inundate his vineyards for twelve consecutive days during July, and again for eight days in October of the same year, and in the following year three inundations were made, with the result that the Phylloxera was entirely exterminated.

The practical outcome of the experiment resulted in the adoption of the method wherever feasible. All soils are not equally suited to this treatment—the best results obtaining in soils which the water will penetrate from one to five centimeters in twenty-four hours. If the soil is so loose and sandy that the water reaches a depth of eight to ten centimeters in this time, the amount of water required will be so great as to render submersion impracticable.

The usual French method consists in dividing the vineyard up into squares or rectangular plats—the former for level and the latter for sloping surfaces—by walls or embankments of earth, these latter being protected from erosion by planting them to some forage crop, commonly White Clover. During the first season the walls are still further protected by coverings of reed-grass, cuttings, twigs, etc. Where possible, canals are taken advantage of as water supplies, but most of the submersions are accomplished by the use of centrifugal steam pumps as represented in the annexed illustration (Fig. 22).

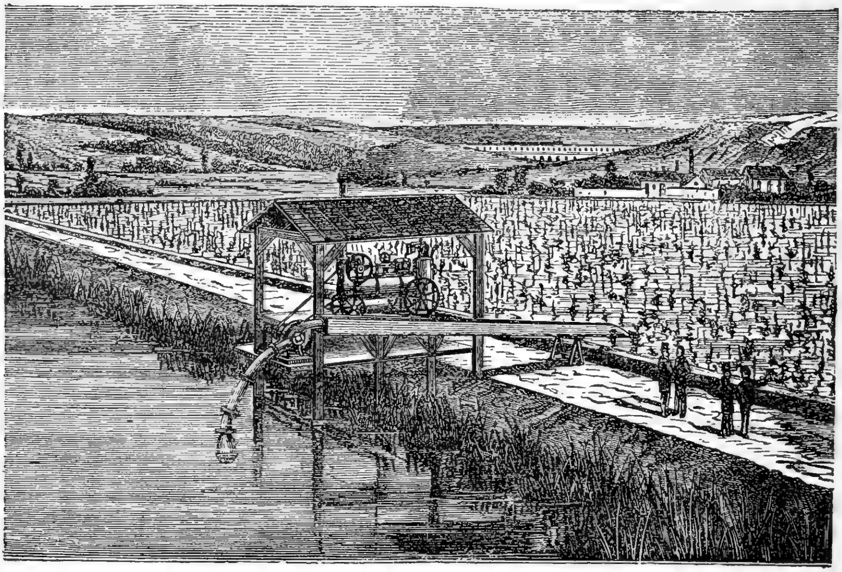

FIG. 22.—Inundating vineyard with centrifugal steam pump. (From Report U. S. Commissioners to Paris Exposition, 1889.)

A recent article, by Prof. B. Chauzit, in the *Revue de Viticulture* (vol. I, No. 4, January, 1894), gives a very succinct and interesting statement of the later methods of treatment in France, which are briefly summarized below:

Following the discovery of the efficiency of submersion, the first ten years, from 1873 to 1883, witnessed the planting in France of thirty thousand hectares of vineyards to be protected by this method; but since the latter date the area of vineyards annually submerged has not very greatly increased. This is due solely to the fact that the use of resistant American stocks, upon which the more susceptible European varieties are grafted, has been attended with such satisfactory results, is so much less expensive, and is capable of employment in all districts and soils; so that the more expensive, if more certain, method of submersion, has not of late years been very much extended. Wherever, however, this method of controlling the Phylloxera has been introduced, often at considerable outlay, there has been no thought of aban-

doning it, and in no case have any of the injurious results which were feared from it at the outset been realized. For instance, the soil has not been appreciably changed in character by the loss of constituent elements, or at least not more than can be easily replaced by suitable fertilizers; nor has there been any packing or other physical changes injurious to vine growth.

In the earlier method of submersion as practiced during the dormant winter period, the length of time during which it was necessary to keep vineyards under water ranged from forty to sixty days; a period which entailed various inconveniences in the matter of amount of water and expense. The aim in more recent years has been to reduce the length of the submergence to as few days as possible, and it is now established that if the application be made during the active period of the Phylloxera, the duration of submergence may be greatly lessened or reduced to from eight to twenty days. It is also very important that the time for submersion should be so chosen that the growth of the plant will not be checked, and both these results are now accomplished by subjecting the vines to the treatment shortly after the gathering of the fruit. At this period the vines have already ceased active growth, but the Phylloxera is still in its full activity and development, and is much more readily influenced by submersion than during the dormant winter period. In general, the earlier the application the shorter the period required, as, for instance, during September, eight to fifteen days will suffice, or in the first half of October fifteen to twenty days, while if it be delayed until November the old period of forty to sixty days will be needed to insure satisfactory results. In connection with the short fall submergence it is found advisable, also, to practice summer irrigation. This operation, which should be the invariable complement of the short autumn submersion, is commonly performed during July, and the amount of water run over the vineyards is very abundant, amounting practically to a forty-eight-hour submersion. At this season submersion or irrigation for the length of time given is most useful to the vines, as it is a period when drought is more or less apt to be prevalent and the beneficial result to the vines themselves largely compensates for the expense of treatment. The surviving Phylloxeræ are also now in active development and most readily destroyed. Successful summer treatment necessitates the training of the vines well above the soil, the surface of which should be carefully leveled.

The vineyards of France where this process is followed are, as a general rule, very productive, and the quality of the fruit and wine product is fully equal to that obtained under normal conditions. It may be that the future will witness the abandonment of this means of controlling the Phylloxera, by the gradual introduction into those districts of the use of resistant American stocks, but this is hardly likely in view of the substantial benefits derived from the treatment, in addition to the very effectual control of the Phylloxera; and if, as stated at

the outset, the increase of submergible areas has not greatly extended of late years, it is to be explained by the cheaper and quite satisfactory results obtained with resistant stocks.

The thoroughly satisfactory results obtained by submersion in France have a particular interest for us on account of the appearance of the Phylloxera in California, where irrigation is largely practiced and where it will be comparatively easy, in many cases, to submerge vineyards in accordance with the methods of the French viticulturists.

The Phylloxera difficulty in France has, after years of discouragement and loss, led to results which have a very substantial value, for it has necessitated an intensive careful culture after improved methods, has led, in many cases, to smaller holdings, and has resulted in better and more abundant and uniform harvests.

With the spread of the Phylloxera scourge over Europe, delegations of viticulturists from Switzerland, Austria, Roumania, and Hungary, have visited France to acquaint themselves with the approved French methods—the information sought being cheerfully given—and recently by request some French experts have visited the region about the Crimea, where the Phylloxera has extended its range within the last few years, to give instruction in methods for eradicating or at least limiting its damage

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ACORN INSECTS, PRIMARY AND SECONDARY.

By Mary E. Murtfeldt, *Kirkwood, Mo.*

Until one carefully examines the acorns of this section of the country it is impossible to realize to how great an extent they are destroyed by insects. Among the latter one or more species of nut-feeding Curculios of the genus Balaninus are the principal depredators. But within recent years a Lepidopterous larva, that may be designated as the Acorn Melissopus, has so multiplied as to become scarcely second to the beetle larvæ in destructiveness; while a third small percentage of the nuts are infested with Cynipid galls and other insects, so that the sound acorns that can be collected during the months of October and November are an almost incredibly small proportion of the entire product of the trees.

During the past autumn I examined many hundreds of acorns of the various species of Quercus abounding in this locality, keeping records of the fruit infested by different insects and making the average of four or five hundreds of each from which to arrange a tabular statement. The result seemed sufficiently remarkable to merit the notice of those interested in forestry and general arboriculture.

The species of Oak most abundant in this vicinity are the Post or Iron Oak (*Quercus stellata* Willd., *obtusiloba* Mx.), Black Oak (*Q. tinctoria*) in varieties, Laurel Oak (*Q. imbricaria*), Pin Oak (*Q. palustris*),

Black Jack Oak (*Q. nigra*), White Oak (*Q. alba*), (*Q. macrocarpa*, *Q. prinus*, and *Q. castanea*. I have not had opportunity to examine any considerable number of the acorns of the four last-named species, but such as I have seen show the work of the same insects as infest the others, of which I have had an almost unlimited quantity.

The following tables will be found approximately representative of the proportion of acorns destroyed by the different insects feeding upon them:

Post Oak (*Q. stellata*) acorns	100
Infested with *Balaninus quercus* and *uniformis*	60
Melissopus latiferreana	28
Sound nuts	8
Shrunken or mildewed nuts	4
Infested by Gelechia following Balaninus	25
Melissopus	5
Black Oak (*Q. tinctoria*) acorns	100
Infested with Balaninus	70
Melissopus	20
Cynipid galls	5
Sound nuts	5
Infested by Gelechia following Balaninus	30
Melissopus	6
Laurel Oak (*Q. imbricaria*) acorns	100
Infested by Balaninus	63
Melissopus	24
Sound nuts	13
Infested by Gelechia following Balaninus	14
Melissopus	9
Pin Oak (*Q. palustris*) acorns	100
Infested by Balaninus	25
Melissopus	10
Sound nuts	65
Have not found Gelechia in nuts of this species.	
Black Jack Oak (*Q. nigra*) acorns	100
Infested by Balaninus	35
Melissopus	50
Sound nuts	15
Gelechia following Balaninus	15
Melissopus	20

From these records it will be seen that the acorns of Pin Oak suffer least from the attacks of insects, that the Black Jack is most subject to the Acorn Codling, and that the Black Oak (*Q. tinctoria*) acorns are the only ones of which any appreciable percentage are, in this locality, infested with the Cynipid galls.

In the preparation of these memoranda the life histories of most of the species have been more or less completely worked out, and such biological facts and descriptions as have not heretofore been published may be perhaps not inappropriately recorded in this connection.

The acorn-feeding species of Balaninus (*B. uniformis* Lec. and *B. quercus* Horn) may be taken here, out of doors, as early as the first of

June, but in the rearing jar none have emerged for me before the 20th of July, and even at the latter date the acorns are not nearly grown. Oviposition takes place mostly during September. On the 29th of that month last year I had the good fortune to observe the process of oviposition in an acorn of Post Oak. While examining a bough for some other purpose a beetle, afterward identified as *B. uniformis*, alighted or crawled upon an acorn within plain sight, and after some preliminary examination finally braced herself with legs widely extended and with a slight upward and downward motion of the head and thorax began drilling into the side of the acorn just beyond the margin of the cup. It took some little time to penetrate the shell, although the latter was still green, but once through this the insect ate her way into the tender cotyledons until the beak was two-thirds buried in the acorn. In this position she remained almost motionless for what seemed several minutes, then slowly withdrew her beak and revolving as though on a pivot applied the tip of her abdomen to the shell, and finally with a delicate sense of touch found the orifice prepared by the beak into which, after considerable delay, the egg was inserted by the somewhat extensile ovipositor. She then again reversed her position and inserted the beak for the purpose, apparently of pushing the egg further into the tunnel excavated for it. As she was again withdrawing her beak I placed her, nut and all, into the collecting box. This transpired late in the afternoon and on the following day the acorn was carefully opened and the oblong, pellucid egg, about one millimeter in length, was revealed, placed on end in the cavity prepared for its reception. Several other eggs in more advanced stages of development were afterwards discovered. These had become somewhat opaque and the segmentation of the embryos was quite distinct.

The larger proportion of the Balaninus larvæ seem to develop with considerable rapidity and to leave the fruit to enter the ground before frost, but a considerable number may be found in acorns at almost any time throughout the winter. It is probable that these, under natural conditions, never develop, but when placed in the rearing jar some of these belated individuals have, for me, attained the perfect form. It is but rarely that two larvæ will be found within a single acorn, but when this occurs, although in small acorns such as those of the Post Oak, there is scarcely enough nutriment for two, yet what there is seems to be equally divided between them. The castings are usually very fine and very compactly pressed together, but in the acorns of the Black Oak sometimes take the form of short, dark threads, intermingled with the woolly fibers of the inner coat of the shell.

HABITS AND ADOLESCENT STAGES OF THE ACORN MELISSOPUS.

Melissopus (Carpocapsa) latiferreana, Wlsm.

This beautiful and interesting species which, with the exception of the Mexican Jumping Bean Moth (*Carpocapsa saltitans*), is the nearest

American ally of the Apple Codling Moth, was first described by Lord Walsingham from probably captured specimens from California, sent to the British Museum. It was placed in the genus Carpocapsa, with which the two available specimens, both females, seemed to sufficiently well agree. It was, however, subsequently ascertained that this description, from a single sex, failed to include certain peculiar and important characters pertaining to the males, namely the mat of spatulate scales near the inner margin of the under sides of the hind-wings and a brush-like tufting of the hind shanks and feet. These characters, with others, were defined by Dr. Riley in a paper published in the Transactions of the St. Louis Academy of Science (vol. IV, 1881), and were considered so divergent from those of any other Carpocapsa as to call for the erection of the new genus Melissopus—from two Greek words signifying "bee-footed" and most applicable to the densely-tufted hind tibiæ and tarsi of the males.

Dr. Riley's paper contained no account of the habits of the insect beyond the statement that it was "bred from acorns, either as a borer or an inquiline," nor, so far as I am aware, has any description of its immature stages ever been published. It is a true acorn feeder, almost contemporaneous in its different stages of development with Balaninus. The moths, like the beetles, are very irregular in date of appearance, beginning to emerge in May and continuing to do so until August. They are not attracted to lamp light and must be, I think, very rarely observed in the open air. Early in September last, between five and six o'clock in the afternoon, I noticed one on an acorn, possibly stationed for oviposition, but on my nearer approach for the purpose of a better view, although done with the utmost caution, the insect was disturbed and flitted away. This is the only one I have ever seen out of doors. The eggs are, in all probability, pushed just under the edge of the cup and the young larvæ find no difficulty in making their way through the most penetrable part of the shell. They begin feeding around the outside of the cotyledons and do not for sometime interfere with the ripening of the fruit.

The full grown larvæ vary in length from 10 to 20^{mm}, and the corresponding diameter is from 2 to 4^{mm}; form almost cylindrical throughout; color dingy white with pale, grayish-brown, glossy maculæ, from which arise very short and fine light hairs. These piliferous spots are largest on the posterior segments and the two dorsal ones often become confluent on the eleventh segment, forming a transverse, oblong band, on each side of which is a somewhat larger and darker plate. Laterally the spots are arranged one directly above and one below the stigmata. Head rather small, only about one-half the general diameter, bright golden brown, with fuscous trophi. Cervical collar entirely covering dorsum of first segment, glossy, dark brown, especially on lateral margins, pale in medio-dorsal space. Legs pale gray-brown; pads of prolegs similarly colored, all very short. Anal shield small, rounded-triangular, clouded, pale brown.

One acorn seldom suffices for the nourishment of a larva, and it cuts its way out of the first and into the second of a cluster through the scales of the cups near the base where the acorns approach each other

most nearly, forming a tunnel of thick, dingy web between the two. In entering a second acorn it not infrequently intrudes upon a Balaninus larva, in which case the latter is literally, as well as figuratively, "forced to the wall." While the caterpillar appropriates to itself all of the remaining provision within the shell, it does not, to the best of my knowledge, include the Curculio larva in its feast, as I have frequently found the latter blackened and shrunken on one side of the coarse, dry, granular castings of the Lepidopter, which are but very slightly webbed. In emerging, when full grown, the larva almost invariably cuts its ragged-edged exit through the involucre as well as the shell of the nut, which Balaninus rarely, if ever, does. It then drops or spins down to the earth, where it forms for itself, against the base of the tree, a slight cocoon, outwardly disguised with bits of bark; or it constructs a nest, flattened, broad-oblong case from the contiguous surfaces of two leaves or of a folded leaf, almost, but seldom quite, severing the margin from the leaves. This case is firmly joined at the edges and slightly lined with silk, and within it the larva remains unchanged for from seven to nine months, transforming to pupa only about ten days before the moth appears. This protracted larval dormancy makes it a somewhat difficult insect to rear, as it must not be kept too dry nor have a superabundance of moisture. The pupa is of a golden-brown color with distinct dorsal sculpturing and spiny ridges, and upon giving forth the moth is protruded more than half way out of the case.

The perfect insect, which varies in wing expanse from 15 to 24^{mm}, is elegant in coloring, with an intermixture of dull red and grayish brown or cream colored scales—the lighter color predominating in some specimens, while the darker does in others. The especial ornamentation consists in three more or less interrupted coppery or bronzy metallic fasciæ; in an indistinct pattern of black streaks and dots near the outer margin of the primaries, and in the heavy, pale-gray fringe succeeding a narrow red marginal line. The under sides of the wings of both sexes have, in some lights, a peculiar metallic green shade. The male is usually one-third smaller than the female, and is most characteristic with his profusely tufted hind legs and feet. The hind-wings are very fragile and at the same time difficult to extend, so that it is by no means an easy task to set the insect without injury to its beauty.

From this species I have bred in small numbers two species of parasites, a *Cymodusa* sp.? and a small Tachinid, which, Dr. Riley informs me, is new to the collection of the National Museum.

CYNIPID GALLS IN ACORN.

In opening acorns of *Q. tinctoria* I have found from five to seven per cent infested by Cynipid larvæ of a species to which Dr. Riley, who has been familiar with them for many years, has given the MS. name *Callirhytis fruticola*. This tiny Hymenopteron converts the cotyledons of the fruit into a mass of small, white, oval cells, the walls of which are excessively hard. From twelve to twenty of these cells are often found

within a single nut and so consolidated that it is almost impossible to detach a cell entire.

I have no records of ever finding these galls in any acorns of other species than those of the Black Oak group, and with us they are mostly confined to the species above named. The winter is passed in the mature larva state which the insect apparently attains in a very brief period of time after the acorn had been stung. I have not yet been so fortunate as to obtain the fly, but Dr. Riley informs me that it was bred by Mr. H. G. Hubbard some years ago and has also been reared by himself.

THE ACORN MOTH.

The remaining species to be considered is the pretty little inquiline *Blastobasis glandulella* Riley, which was originally described under the popular name of the "Acorn Moth." Dr. Riley published his descriptions of the species in the *Canadian Entomologist* (vol. IV, p. 18) and in his Fourth Annual Report on the Insects of Missouri.

The larva is a very lively, slender, subcylindrical caterpillar of a translucent pinkish or yellowish-white color with broad, pale brown, corneous head and shield. It is to be found during winter in a very large proportion of the acorns vacated by Balaninus as well as in some of those first occupied by Melissopus. After hatching, its first energies seem to be devoted to closing the small circular orifice through which its predecessor made its exit and into which its Tineid parent had dropped the egg that produced it. It seems almost incredible that so tiny a larva could spin so much and so dense web as is required for this purpose. These larvæ, when found following Melissopus, do not seem to find, in the débris of the latter, as much or as palatable nutriment as that to which they were no doubt originally adapted, for they are, as a rule, small and retarded in development, and no doubt, in many cases, perish. In the castings and crumbs left by the Curculio, however, they find a rich feast which they appropriate but slowly, as the growing period lasts through the entire winter. Their own castings are webbed into a compact bundle wrapped in white silk on the surface of which they rest.

The transformations usually take place within the acorn, but in some instances the larva comes out and spins a tough, oval cocoon among a cluster of nuts or against a dry leaf or on the surface of the soil. The moths appear at intervals throughout the summer and may be taken in the net by sweeping the surface of the ground under oak trees. They are also somewhat attracted by lamplight and frequently enter rooms at night.

Of other insects that have been found in acorns may be mentioned several specimens of *Phycis* (*Canarsia*) *hammondi* Riley or a species closely allied to the latter, which emerged last spring from acorns in my rearing jars. The probability in this case is that the larvæ, which

are known to feed upon the leaves of oak, had merely, on completing their growth, entered the acorns for shelter while undergoing their transformations.

A small Carabid larva, not yet bred, is also occasionally found in the débris of other insects inside the acorn, and in one of the latter which I recently opened were a number of minute, salmon-colored Dipterous larvæ having the appearance of a Cecidomyiid.

These include all the acorn insects that I have found during the two or three years that I have had them more especially under observation, but no doubt, in other sections of the country, still other species occur so that the list is merely locally complete up to date.

PRELIMINARY REPORT ON SUPPRESSING THE SAN JOSÉ SCALE IN VIRGINIA.

By D. W. Coquillett.

The following is a brief account of an attempt recently made under instructions from Dr. Riley, to eradicate the San José Scale (*Aspidiotus perniciosus*) in the vicinity of Charlottesville, Va.

From examinations made it would appear that the area of infection is nearly in the form of a parallelogram, measuring 75 yards from east to west, and 350 yards from north to south. The trees upon which the pest was supposed to have first appeared are located nearly in the center of this area, and it is curious to note that while these insects have spread to a distance of about 175 yards, both north and south of the original source of infection, their distribution to the east or west has been only about one-fifth of this distance. This is the more singular, owing to the fact that these insects depend largely upon the winds to transport them from tree to tree, and in the present instance the direction of the prevailing winds is from west to east, occasionally changing to the northwest or southwest, but very seldom or never blowing from the north or south. This unequal distribution is not due to the lack of suitable plants, since in many places both east and west of the infested area are growing the same kinds of plants and trees as those already infested. It is, therefore, very singular that these insects should have spread five times as far in two directions as they have in the other two.

Having previously dispatched the apparatus and chemicals to be used in this work, I proceeded to Charlottesville on the morning of the 12th of March, and interviewed Dr. C. H. Hedges, the owner of the originally-infested trees, who drove me to the residence of Mr. H. L. Lyman, one of the members of the Virginia State Board of Agriculture. Mr. Lyman, in accordance with a resolution adopted by the Board, agreed to furnish a sufficient number of men to operate the tents during the process of treating the infested trees with hydrocy-

anic acid gas. Accordingly, on the morning of the 13th, the work of disinfection was commenced.

The tents used for the purpose of inclosing the infested trees are made of 8-ounce duck, oiled with linseed oil. They are in the form of octagonal sheets, and are four in number, two of them being 28 feet in diameter, while the other two measure 44 feet. These could be placed over the trees by hand, or by the use of poles when the trees did not exceed 10 feet in height, but on larger trees it was necessary to use a sort of tripod for the purpose of placing the tents over them. This apparatus consists of two pine scantlings, each two by three inches thick and twenty feet long, fastened together at the upper end by a bolt having a ring in place of a head. To this ring is attached the pulley through which passes the rope used in hoisting the tent. To the opposite or lower end of each of these scantlings is fastened a cross-piece of 6-inch pine board, one of the cross-pieces being 18 inches, the other 5 feet long, and having a brace extending from each end to the scantling, to which it is fastened at a point 5 feet from its base. These cross-pieces serve the purpose of keeping the tripod in an upright position, and in actual practice were found to be sufficient for this purpose.

When the tent is to be placed over a tree, it is spread out on one side of the tree and the tripod erected on the opposite side and as close to the base of the tree as it is possible to get it; one end of the five-sixteenths-inch rope passing through the pulley at the upper end of the tripod is furnished with a strong iron hook, which is next hooked into a loop attached to the tent, after which the opposite end of this rope is drawn downward until the tent is drawn to the top of the tripod; the foot of the latter is moved several feet farther from the tree and the tent again drawn over the tree until it will cover the latter, after which the tent is allowed to drop over the tree.

The chemicals used in generating the hydrocyanic acid gas consist of fused potassium cyanide of about 58 per cent purity, commercial sulphuric acid, and water, the proportions being 1 ounce by weight of the cyanide, a trifle over 1 fluid ounce of the acid, and 3 fluid ounces of water. This will be sufficient for 150 cubic feet of space inclosed by the tent; by computing the number of cubic feet thus inclosed and dividing this by 150 we obtain the quantity of cyanide in ounces and fractions that the tree will require, after which it will be comparatively easy to ascertain the quantity of each of the other ingredients required by bearing in mind that each ounce by weight of the cyanide will require slightly over a fluid ounce of the acid and 3 fluid ounces of water.

Almost any glazed earthenware vessel will answer the purpose of a generator. I used 1-quart pitchers; also an open vessel holding about 1 gallon, and a 2-gallon jar. The pitchers were large enough for using 2½ ounces or less of the cyanide, but when a somewhat larger quantity than this was used the action of the chemicals resulted in throwing a portion of them out of the pitcher, thereby occasioning a loss. On

the largest tree subjected to the gas I used 18 ounces of the cyanide and the other ingredients in their proper proportions, employing the 2-gallon jar for a generator, and this was large enough to contain the chemicals during the process of generating the gas.

Altogether, I treated 326 trees and shrubs with this gas; these are as follows: pear, 187; apple, 8; quince, 4; plum, 24; peach, 13; cherry, 22; gooseberry, 17; currant, 9; *Eleagnus longipes*, 5; rose, 25 and lilac, 12.

After the tent was placed on a tree and charged with the gas it was allowed to remain on the tree for half an hour. Four men could remove the four tents from the trees, place them over others, and charge them with gas in from fifteen to twenty minutes, according to the size of the trees. Six tents could easily have been operated by this number of men without any loss of time, since the tent first placed over a tree would be ready for removing by the time that the last tent was charged with the gas. This would result in treating twelve trees an hour, but in the case of small trees and shrubs several of these could be treated at a time by one of the tents.

The chemicals used in this work were furnished the Division by one of the druggists of this city—the potassium cyanide at 60 cents per pound and the sulphuric acid at 3½ cents per pound. It is worthy of note that the fruit-growers of Southern California obtain this same brand of cyanide (Powers and Weightman's 58 per cent fused) at 39 cents per pound, and that, too, after paying the freight on it almost across the continent. About 42 pounds of the cyanide and 90 pounds of the acid were used in treating the 326 trees and shrubs above mentioned. Assuming that the cyanide could be obtained at the same price that it can in California, that the four men could be employed at $1 per day, and that they could treat an average of twelve trees an hour, working ten hours a day, gives us the following as the probable cost of treating the 326 trees and shrubs mentioned above:

42 pounds cyanide, at 39 cents per pound	$16.38
90 pounds sulphuric acid, at 3½ cents per pound	3.15
4 men 2⅔ days, at $1 each per day	10.66
Total	$30.19

This is an average of slightly over 9 cents for each of the 326 trees and shrubs treated with the gas.

It was anticipated that considerable difficulty would be experienced in operating the tents on the leafless trees, which are so different from the Citrus trees, upon which this treatment has been principally performed in the past; but, with the exception of some large pear trees, the branches of which were more rigid and brittle than those of the other trees, but little trouble was experienced in this direction. It was found expedient to draw the tents off of the trees in the same direction that they were drawn on; any attempt at taking them off in an opposite direction is almost certain to result in the breaking of the branches.

NOTES FROM CORRESPONDENTS.

Icerya montserratensis in Colombia.—Dr. S. A. Davis, of New York City, has sent us a vial containing full grown females and newly hatched larvae of *Icerya montserratensis*, which he collected upon American rose bushes at Colon, Isthmus of Panama. He says that a friend tells him that the insect is abundant in the interior of Colombia. This interesting sending adds a new food-plant and a new locality for this beautiful species, which was first described in INSECT LIFE (vol. III, pp. 99-103).

Danais archippus in Chile.—Mr. Edwyn C. Reed writes us that he has reared this large cosmopolitan butterfly from the larva, in Chile. This point is of great interest, as Scudder states that the species is distributed in South America only east of the Andes and north of Rio, although it has recently been reported by Dr. Carlos Berg from Patagonia.

Kerosene against Mosquitoes.—Mr. John B. Lembert, of the Yosemite National Park, writes us that the miners in the Minaret mining district make a mixture of kerosene and mutton tallow, and smear their "burros" with this ointment. This gives the little animals perfect immunity from the mosquitoes, while without it their heads become simply a crust of dried blood on the outside, so abundant are mosquitoes and horse flies.

Two more Cases of Bots attacking Cats.—Mr. Walter H. Harrison, of Columbia County, N. Y., writes us that last summer he removed larvæ from the side of the eye and from the back of a cat belonging to his family. The specimens unfortunately were not saved. Mr. William Mansbridge, writing from St. Louis, states that one of a litter of six kittens was attacked, and when six weeks old a large bot three-fourths of an inch in length was found in the side of its neck.

The Azalea Scale in Michigan—Mr. G. C. Davis, of Agricultural College, Mich., sends us specimens of the somewhat rare and interesting *Eriococcus azaleæ* Comst., occurring upon Azalea plants at the Agricultural College. This insect has not yet been found out of doors, and it will be interesting to know its natural habitat.

Parasite of the Cynthia Silkworm.—We have just received further specimens of *Spilochalcis mariæ*, the well known American parasite of the larger native silkworms, from Mr. Townsend, Kingston, Jamaica. This parasite, as we have already shown, reached Jamaica by way of England, having probably been sent to some entomologist in the latter country for curiosity or experiment.

The "Sacred Silkworm of India" Hoax.—Some time ago in the Southwest, and particularly in New Orleans, eggs of the so-called "sacred silkworm of India" were offered for sale, with the statement that the larvæ would feed only on the castor-bean plant. We suspected dishonesty in this enterprise, but have only recently received specimens of the insect, the eggs of which were sold under these pretensions. It proves to be the common Polyphemus moth, which, as everyone knows, is an indigene of this country.

Scale-insects on Ivy.—Mr. T. D. A. Cockerell writes us that he is making a special study of the scale-insects affecting the ivy plant. Incidentally he announces that he suspects the old and well-known *Aspidiotus nerii*, so commonly found upon Ivy and Oleander in this country, to be synonymical with the *Aspidiotus hederæ* of Europe. We are not inclined to admit this synonymy as yet, but the possibility is interesting.

Wireworm in the Burrow of an Apple-tree Borer.—Mr. Barry C. Hawkins, of Horse Cove, N. C., sends us the larvæ of a click beetle of the genus Corymbites, which he took from the burrow of the common Round-headed Apple-tree Borer, *Saperda candida*. The entrance hole was near the ground, and the Corymbites larva had apparently destroyed the borer.

Persimmon Root-borer.—There is an interesting Sesiid moth, described by Mr. Ridings as *Phemonoe 5-caudata*, which we ascertained, some years ago, to feed in

the larval state in the roots of Persimmon in Florida. We have recently received larvæ of the same insect in the roots of persimmon saplings from Delaware, and during April the same thing came to us from our friend and correspondent, Mr. G. C. Brackett, Lawrence, Kans. The species therefore is widespread, and probably being still more widely spread by the recent traffic in persimmon nursery stock.

Box-elder Plant-bug in Houses.—Mr. William M. Freeman, of Dayton, Wash., has recently sent us specimens of *Leptocoris trivittatus*, with the statement that it occurs in numbers in his house. We have previously recorded instances of this kind. The insect feeds upon box-elder shade trees and hibernates in the adult stage, seeking the warmth and shelter of dwellings. We have heard unsubstantiated rumors that the insect will enter beds and bite human beings under these circumstances.

Cottonwood Scale insects.—Mr. Lawrence Bruner has found in Nebraska two scale-insects which injuriously affect the cottonwood tree. One of these is Comstock's *Chionaspis ortholobis*, and the other is a larger and undescribed species of the same genus.

Larvæ in a Child's Face.—Our note under this head published on page 270 of the last number of INSECT LIFE has attracted the attention of Prof. Raphael Blanchard, the eminent French naturalist, who is anxious to secure specimens. We have been unable to get any as yet. Prof. Blanchard has especially studied the subject of these Dipterous parasites of human beings, and has published several important papers on this topic. Readers of INSECT LIFE are requested to report any new cases which may come under their observation.

Clover-leaf Beetle in Maryland.—A great abundance of *Phytonomus punctatus* around Washington has been noticed for some years past. The fungus disease which has carried off the larvæ of these beetles in such great numbers in New York and Pennsylvania has also been observed in this vicinity. We have recently received specimens from western Maryland, with the information that the insect is doing great damage to the clover crop this spring. The fungus disease has not been noticed in the locality. This case is so serious that the plowing under of the crop has been advised.

Galls on the Roots of Poison Ivy.—Mr. Walter H. Harrison, of Lebanon Springs, N. Y., sends us some small oval fleshy galls found on the roots of *Rhus toxicodendron*, which are evidently the work of a Cecidomyiid larva. The species is new to the National Museum collection and the adult is not known.

Early Appearance of Benacus griseus.—Mr. C. F. Stamm, of Chestertown, Md., sends us an active specimen of the Giant Water-bug (*Benacus griseus*) which was captured at Chestertown on the 26th of March.

A Walnut Scale on Pear.—Prof. H. A. Morgan, of Baton Rouge, La., has made an interesting find. The English Walnut Scale (*Aspidiotus juglans-regiæ*) described by Comstock in the Annual Report of this Department for 1880 (p. 300), from specimens found on an English walnut tree at Los Angeles, Cal., is found by Prof. Morgan to occur in numbers upon pear trees near Baton Rouge. This is another of the scale-insects of very considerable economic importance, the original home and spread of which have not been successfully studied, although it is probably an American species.

GENERAL NOTES.

NEW JERSEY'S PROPOSED LEGISLATION AGAINST INSECTS.

In the department of Economic Entomology of *Entomological News* for February, 1894, Prof. John B. Smith discusses the subject of legislation against insects, and gives the text of a law drafted by a com-

mittee of the State Horticultural Society to prevent depredations by insects injurious to the agricultural and horticultural interests of the State, which is to be submitted to the legislature of the State at the present session by the legislative committee of the State Board of Agriculture. The act provides tnat whenever requested by a resolution of any county Board of Agriculture the Executive Committee of the State Board of Agriculture shall appoint three persons to act as commissioners for the purposes of the act, such commissioners to be paid a reasonable allowance out of the fines and costs collected under the further provisions of the act. When complaint is made to such commissioners that any agriculturist has neglected or refused to employ the methods prescribed by the State Agricultural Experiment Station for the destruction of injurious insects notice shall be served in writing upon such person, specifying the insect or insects complained of, and said notice shall be accompanied by a reference to the reports of the Experiment Station where the proper remedy is prescribed, or a printed copy of the proper bulletin or report may be served with the notice. It shall be the duty of the person so notified, within twenty-four hours, to proceed to destroy the insects complained of on his lands in the manner prescribed; and failure to do so within six days after receipt of notice shall render him liable to a fine of not less than twenty-five nor more than one hundred dollars, in the discretion of the Court. The act to take effect immediately upon its passage.

Of the committee which drafted this act Professor Smith was himself a member, and while admitting the justice of the proposition that the careful agriculturist, who exerts himself to keep down insect pests, should not be handicapped by the negligence of his neighbors in this respect, he is convinced that it will be almost impossible to enforce any law on the subject, the sentiment against informers rendering it extremely difficult to secure convictions on their testimony. The act as drafted, however, is to be called into effect only through the action of the County and State Boards of Agriculture, thus throwing the burden of enforcing it upon the official organization of the farmers, and, as Professor Smith remarks, where there is sufficient public sentiment to secure its enforcement such a law will not be a dead letter.

INSECT LEGISLATION IN AUSTRALIA.

The fruit-growers in Victoria, in spite of their strenuous efforts in favor of the noxious insect bill were unable to secure its passage through the last Parliament, which dissolved without giving such a bill consideration.

LEGISLATION AGAINST INSECTS IN MASSACHUSETTS.

On another page we have noticed the proposed legislation against injurious insects in the State of New Jersey. Similar but less stringent measures were some time ago adopted by the Commonwealth of Massa-

chusetts to protect the orchard and shade trees, that are properly cared for by their owners, from insect pests which are permitted to breed unrestricted in public highways and waste places.

The act in full is reprinted herewith:

AN ACT to provide for the Extermination of Insect Pests.

Be it enacted, etc., as follows:

CHAP. 78, SECTION 1. Cities and towns shall raise annually by taxation and appropriate such a sum of money as they may deem necessary, to be expended under the direction of the mayor and aldermen in cities and the selectmen in towns, in exterminating insect pests within the limits of the highways in their respective cities and towns, and in the removal from said highways of all trees and shrubs upon which such pests naturally breed: *Provided, however*, That where the owner or lessee of real estate abutting on the highway shall annually exterminate all insect pests from the trees and shrubs along the highway where said real estate abuts thereon, such trees and shrubs shall be exempt from the provisions of this act.

SECTION 2. This act shall take effect in any city when accepted by the city council, and in any town when accepted at a legal town meeting called for that purpose. [Approved March 9, 1893.]

THE INSECTS SUBJECT TO PARASITISM.

On page 201 of the current volume is printed a paper by Mr. C. H. Tyler Townsend, entitled "Dipterous Parasites in their relation to Economic Entomology," which, although reaching the secretary of the Association of Economic Entomologists too late for presentation at the meeting, was submitted by him for publication in INSECT LIFE, together with the rest of the official minutes. As a part of these minutes it was published in this periodical, but a somewhat serious misstatement occurs in the second paragraph, to which it is worth while to call attention. Inasmuch as no general notes were published in that number, this statement is properly made at this time. Mr. Townsend says:

> Of the sixteen orders of insects, as evolved by Brauer and now generally accepted, only five are subject to parasitism. These are the Orthoptera, Hemiptera, Coleoptera, Lepidoptera, and Hymenoptera. * * * The Hymenoptera attack the last four, including their own order. The Diptera, however, furnish parasites upon all five of these orders.

We wrote to Mr. Townsend concerning this error and he replied that it occurred through the fact that his library had not yet followed him to Kingston from Las Cruces, and that he was, therefore, obliged to generalize from memory. He requested us, however, to make the proper correction. As a matter of fact, certain of the Diptera themselves, the Neuroptera, the Odonata (egg state only), and the Platyptera are parasitized as well as the five orders mentioned by Mr. Townsend. Thus, the number of orders subject to parasitism is nearly doubled. Instances of the parasitism of insects of the four orders which we have added will occur to most entomologists. It will be noticed that Mr. Townsend also excludes the Orthoptera from the Hymenopterous parasitism, whereas the well known occurrence of Eupelmus in the eggs of katydids and of

other Hymenoptera in cockroach egg-cases, as well as the occurrences of both Chalcidids and Proctotrypids in the eggs of certain crickets, to say nothing of the fact that the large genus Scelio lives exclusively, so far as we know, in the egg-pods of Acridiidæ, should have been remembered.

Mr. Townsend's misstatement has met the critical eye of M. A. Giard, of Paris, who has written us, giving a number of known instances of parasitism in Diptera and Neuroptera. He also remarks that Mr. Townsend has overlooked the recently discovered parasitism of Homoptera by Elenchus. The subject of Parasitism in Insects was chosen for the annual address of the president of the Entomological Society of Washington for the year 1892, and was uppermost in our mind at the time, but we did not notice the above oversights, because they were in official minutes.

COLORADO INSECTS.

Under the title "Entomology of the Mid-Alpine Zone of Custer County, Colorado," Mr. T. D. A. Cockerell brings together the results of his somewhat extensive collecting during his residence in Colorado some years ago. He catalogues about a thousand species, which, although it may seem a small number to those who have collected only in regions of lower elevation, is probably fairly representative of at least the character of the insect fauna of the region described, which extends from 6,500 feet to 10,000 feet. It is essentially a zone of oak scrub and quaking aspen. The characteristic plants, birds, and mollusks of the region are mentioned briefly. The Coleopterous fauna is largely boreal, with a slight southern element and a fair number of species endemic in the Rocky Mountains. The butterflies are boreal, with a strong western element. The author discusses the question of zoological regions, particularly in reference to the system adopted by Dr. C. Hart Merriam, and briefly touches upon many interesting topics, such as the origin of the Rocky Mountain fauna, the fossil insects of Colorado, the glacial epoch, remnants of the ancient fauna, post-glacial development, and species-forming areas. The data are probably insufficient for so comprehensive a summing up, but the paper is interesting and suggestive, and the list will form a basis upon which Colorado entomologists may work.

LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

The Transactions of the London Entomological and Natural History Society for 1893 has recently been issued in a pamphlet of some eighty pages of closely printed matter. It includes reports of the meetings of the Society from December 20, 1892, to December 5, 1893, together with abstracts of the papers read and an appendix consisting of papers presented up to March 16, 1893. The following is a list of the more important articles: Specific nomenclature, present, past, and future, by

Dr. F. J. Buckell; Melanchroism in British Lepidoptera, by J. W. Tutt; The history of butterfly classification, by Dr. Buckell; Is moisture the cause of melanism, by J. E. Robson; Notes on certain coleopterous insects found in city warehouses, by G. A. Lewcock; The Genus Silpha, Linné, by W. F. Johnson and G. A. Lewcock. All of the above papers are of considerable general interest, particularly to Lepidopterists and Coleopterists; the article on Coleoptera found in city warehouses is, however, of special importance, as it bears on the habits of several species that have become introduced in this country by commerce. Of those receiving special mention *Dermestes lardarius*, *Sitodrepa* (*Anobium*) *panicea* and *Ptinus fur* are well-known injurious species, while a considerable portion of the others occur here.

ENTOMOLOGICAL MATERIA MEDICA.

Persons interested in this subject will find a very good compilation of the insects used in medicine in a paper by Richard Ernest Kunze, M. D., of New York, read at the World's Medical Congress, June 2, 1893. The paper is sent to us as a pamphlet issued by the author, and we are unable to give any further facts concerning its publication. The entomology of the work is rather weak, old names being given throughout and many of these misspelled, but this is by no means a serious blemish, and the paper brings together many interesting facts.

LE NATURALISTE CANADIEN.

Since the death of that learned and hard-working entomologist, the Abbé Provancher, the publication of *Le Naturaliste Canadien* has been interrupted. We are glad to receive the first number of volume XXI, published January, 1894, as an evidence that the journal has been revived. The editor and proprietor is, as was our lamented friend and correspondent, a Catholic priest, the Abbé V. A. Huard, who is also, fortunately for our science, an entomologist. He announces in this number, however, that while the journal will occupy itself especially with entomology, other departments will be represented.

A NEW CANADIAN JOURNAL.

We have just received a copy of the first number of the first volume of the *Biological Review of Ontario*, a neat little journal published at Toronto. The contents are mainly ornithological, but the first number contains an article by our friend and correspondent, Dr. William Brodie, on "Canadian Galls and their Occupants," which seems to be introductory to a series to be published under this title. The present installment contains an account of *Diplosis erigeroni* n. sp., giving Dr. Brodie's field and rearing notes on an interesting new gall, which he finds on *Erigeron canadense*, variously situated from the base of the stem to the tips of the branches of the flowering panicle. The galls are

irregularly cylindrical, tapering at both ends, and those on the branches are more or less spherical. A second article, by George Brodie and W. A. Brodie, records the occurence in great numbers of the common Red-legged Locust, *Caloptenus femur-rubrum*, during the summer of 1893 in the middle and eastern counties of Ontario. Many thousands of dollars worth of farm products were destroyed over the infested area.

INSECT INJURIES IN NOVA SCOTIA.

We learn from the annual report of the Secretary of Agriculture of Nova Scotia for 1893 that damage by the Colorado Potato Beetle has grown less, but that considerable damage has been done to various crops by locusts, while perhaps the most serious insect depredations of the season have been accomplished by the Bud Moth (*Tmetocera ocellana*), although the species is not identified. In certain localities one-third of the apple crop was destroyed by this species, the crop of Nonpareils being almost entirely lost.

INSECTS OF ALDABRA, ASSUMPTION, AND GLORIOSO ISLANDS, INDIAN OCEAN.

In a short paper published as No. 973 of the Proceedings of the U. S. National Museum, Dr. W. L. Abbott gives a brief report on the natural history of these islands, in which is included a list of the insects. The species, as a general thing, are those of south and east Africa. The Museum has received other collections also made by Dr. Abbott, from the Seychelles Islands and from east Africa, the largest amount of material having been taken in the interesting Kilimanjaro region. This material is being slowly worked up by specialists, and the reports when completed will form an important contribution to the geographical distribution of insects.

INSECT PESTS OF QUEENSLAND.

The Department of Agriculture at Brisbane has published as Bulletin 25 a report of the agricultural conferences held at Beenleigh, Bundaberg, Rockhampton, and Mackay. Among the interesting discussions which were held at these conferences, and which are reported with great fulness in this bulletin, we notice an important paper upon insect pests by Mr. R. E. Turner, which was read at the Mackay conference. Mr. Turner treats at considerable length the insect enemies of the sugar-cane in Queensland, and considers that the decrease of the native insectivorous birds, owing to their indiscriminate destruction by the Kanakas employed on the plantations, has a great deal to do with the increase of sugar-cane insects, particularly white grubs, which have of late been so abundant. These people, it seems, spend their Sundays destroying the birds. The borer moth, Mr. Turner thinks, may be identical with *Diatræa sacchari* but is certainly distinct from *Proceras*

sacchariphagus, which is the most serious cane pest of Mauritius. The insect enemies of Citrus fruits are considered at some length. With the scale-insects we are already familiar through the reports of Mr. Koebele's trips to Australia, as well as the reports of Messrs. Tryon and French. Outside of scale-insects, however, oranges are damaged in Queensland by the larva of *Papilio erectheus*, which works in the same manner as the congeneric "orange dog" of Florida. Queensland possesses a new type of orange insect, however, in the shape of several species of Noctuid moths, of which *Ophideres fullonica* is the most prominent, and which ruin the fruit by inserting their haustella and sucking the juices in just the same way that the Cotton Moth damages figs in our Southern States.

COFFEE INSECTS IN HAWAII.

In the *Planters' Monthly* for December, 1893, published at Honolulu, Mr. William G. Wait gives an interesting summary, upon pages 559–562, of the insects which he has found affecting the Coffee-tree in the Hawaiian Islands. The insects considered are all scale-insects and comprise *Dactylopius destructor*, *Pulvinaria camellicola*, and an undetermined species of Lecanium. The author has found *Coccinella abdominalis* and a species of Scymnus breeding upon the Dactylopius and *Coccophagus hawaiiensis* How. MSS., and *Dilophogaster californica* parasitizing the other two species. A smut fungus (*Capnodium lanosum*) follows the scale-insects and does more damage to the plant. The fungus is eaten by a species of Psocus, colonies of which live in gauze tents on the under surface of the leaves.

ABUNDANCE OF WASPS IN SOUTH BRITAIN.

In *The Entomologist* for January, 1894, Mr. W. Harcourt Bath records that in every part of south Britain visited by him, wasps have swarmed in countless numbers during the past season, in some districts doing great damage to the fruit crops. He attributes the abundance of the swarms to the dry weather of the preceding spring.

AN UNNECESSARY CASE OF PROTECTIVE RESEMBLANCE.

Mr. John T. Carrington, in *Science Gossip* for March, 1894, in an interesting little article upon roosting butterflies, brings out a number of interesting cases in which butterflies, in choosing their "roosting places" select locations in which they will be protected by their resemblance to their surroundings or to the object upon which they roost. Curiously enough, he republishes from INSECT LIFE the figure of *Anosia plexippus* published upon page 206 of volume V, in which the butterflies are roosting in numbers upon a dead twig. Here, says Mr. Carrington, resemblance to a twig covered with dead leaves is plainly aimed at, and this resemblance is protective. To a person giving a

casual glance at the figure this seems very apt, but when we remember that this particular butterfly needs no protection; that it is one of the markedly distasteful species; and that it is mimicked by other butterflies in different parts of the world on account of the fact that it is so distasteful—we see at once that it needs no protective resemblance, and that therefore Mr. Carrington's idea is quite fanciful. In settling in vast numbers upon a branch these butterflies could not well take any other positions and be at peace with each other.

ON THE LARVA OF EPHESTIA KUEHNIELLA.

Apropos of our review on p. 44 of the current volume of INSECT LIFE of Mr. Danysz' paper concerning the embryonic testicle of the larva of *Ephestia kuehniella*, M. A. Giard calls our attention to Mr. E. B. Poulton's paper in the Transactions of the Entomological Society of London, for 1888, in which the same facts are virtually given. For the moment we had overlooked the fact that this discovery had previously been made by Mr. Poulton.

PARASITE OF THE JAPANESE GYPSY MOTH.

Last November we received from the Rev. H. Loomis, of Yokohama, a small box containing cocoons of a Microgaster parasitic upon *Ocneria japonica*, which, it will be remembered, we are trying to introduce for use against the Gypsy Moth in New England. Upon examination it was found that the majority of the cocoons were empty, and a large proportion had been infested with a secondary parasite of the subfamily Pteromalinæ.

THE EFFECT OF LOW TEMPERATURE UPON SILKWORM EGGS.

In the January, 1894, issue of *Le Naturaliste*, M. Henri Coupin reviews the experiments of M. Pictet, of Geneva, on the influence of low temperatures upon animals. Among the curious observations made by M. Pictet, those upon the living eggs of silkworms have a peculiar interest from the fact that a practical result of some importance was unexpectedly arrived at.

It was found that silkworm eggs could be subjected to a temperature of $-40°$ (presumably Centigrade) without endangering their development, and that when the refrigerated eggs were taken out of the cold chamber and subjected to normal conditions of temperature at the time of the leafing of the mulberry trees, they hatched with almost no risk of attack by the maladies which are so common to silkworm eggs that have been left to themselves and have endured several months of fluctuating temperature. In other words, the parasites of the eggs do not, under conditions of low temperature, find themselves in a situation favorable to their growth, and the worms issue practically insured against the risks so formidable to them and to the silk industry.

FURTHER FACTS ON ERASTRIA SCITULA.

Through the kindness of M. A. Giard we have been made acquainted with the interesting observations of Capitaine Xambeu, of Ria, Pyrenées Orientales, upon this predaceous Lepidopteron, an account of which was published in *Le Naturaliste* for August 15, 1891. M. Xambeu gives a very careful account of the life-history of the insect, agreeing in nearly all respects with that made out independently by Dr. H. Rouzaud, which we have recited at some length in No. 1 of the current volume of INSECT LIFE. We promised an attempt at an introduction of this insect into the olive-growing regions of California at the earliest possible moment. Unfortunately Dr. Rouzaud's duties as member of the Chamber of Deputies at Paris have prevented him from attempting the sending of living specimens of this important beneficial insect to this country; and further he writes us that during 1893 the species has been extremely scarce at Montpellier. Inasmuch, however, as Capt. Xambeu reports it as very abundant at Ria, we have written him in the hope that he will be able to send living specimens in the hibernating condition before the winter season is passed. We have little hope of being able to introduce the species except during the winter.

A STRIKING INSTANCE OF RETARDED DEVELOPMENT.

On September 20, 1893, Mr. Albert Koebele wrote us from Alameda, Cal., to the effect that while engaged some two weeks previously in cutting up some of the Yucca stems which he had collected in Los Angeles County May 17, 1887, two fresh and healthy larvæ of Prodoxus were found still present, spun up. There were large numbers of other larvæ that had died. The living ones will not issue before the coming spring, which will make them seven years old. We have called attention in our writings on the Prodoxidæ, to the tendency to retardation in development, but the period of latency experienced by Mr. Koebele is the longest so far recorded.

AN UNUSUAL EXPERIENCE WITH CABINET BEETLES.

An Iowa correspondent, Dr. J. M. Shaffer, writes us, under date of March 14, of a very unusual experience with the common Cabinet Beetle (*Anthrenus varius*). Three years ago he had twenty cases of insects destroyed by this species in spite of treatment with camphor, chloroform, and benzine. Boxes, insects, and all were saturated with benzine, but without producing satisfactory results. An Acridium, he writes, was captured and mounted in October, and placed in a drawer with other insects. A few days later the grasshopper was discovered half eaten, and, on being broken open, found to contain Anthrenus larvæ. The only explanation that we are able to give without personally visiting the premises is that the building in which the insect collection is kept, and which Dr. Shaffer informs us also harbors other collections of

natural history, is overrun with the little pests, and as fast as the insecticides used in the boxes evaporate other individuals of Anthrenus replace such as have been killed. A thorough search in such cases might reveal a box of neglected specimens somewhere in which the Anthrenus are breeding. Our correspondent was advised to subject the room in which his collection is stored to a thorough fumigation with bisulphide of carbon or benzine, to be repeated in a month or six weeks later and again in the summer, if these two applications were not thoroughly successful.

INSECT DAMAGE TO BEER-CASKS IN INDIA.

We have just received from the author, Mr. Walter F. H. Blandford, a most thorough and interesting report on the destruction of beer-casks in India by the attacks of a boring beetle (*Xyleborus perforans*). We have, in one of the earlier numbers of INSECT LIFE, incidentally mentioned this peculiar damage which has for many years been a source of trouble to the officers in the Commissariat Service of the Government of India. Burrows or tunnels are excavated from the outside of the cask-wood and run in various directions in its interior, a certain proportion of them being continued through the wood so as to cause leakage and subsequent souring of the beer which remains. These attacks have been known certainly since 1850, and there has been considerable controversy as to whether they originate in England or are brought about after the arrival of the casks in India. In general the officials in India have been looking to England for the remedy, whereas, as Mr. Blandford shows, the damage originates after arrival in the East, and remedial work should have been done there. The paper includes a full summary of previous reports on the subject; an account of the source of information of the author; the zoölogy of the borer; its habits in its different stages; its geographical distribution; a somewhat general consideration of the insects found in Oak timber; the circumstances influencing the attack in India, such as the construction of the go-downs or store-houses; the commencement of the attack during inland transit of casks; quality of the cask-wood; time of storage, and the extent of the damage. He shows conclusively that all attacks on casks have begun in India and not in Europe nor in any recorded instance on shipboard. The perfect insect bores into the cask and lays its eggs in the burrow. It attacks the wood and selects the moister part around the bung. Casks of thin wood suffer most. As a rule the inner surface is not reached. The insect permanently infests the store-houses and go-downs and is most injurious in those structures in which jungle-wood and bamboos are used. The author recommends the construction of casks out of thicker staves and hoops and the use of cask-enamel to keep the wood drier. As a protection for uninjured casks a large number of substances are mentioned, but thorough experiments do not seem to have been made. Treatment with quassia. lime, or creosote are those from which the best results are to be expected,

Suggestions for the construction of store-houses and particularly of wood from which they should be built are made. Teak-wood is recommended and bamboo should be avoided.

WORK OF THE GYPSY MOTH COMMISSION IN 1893.

The report of the Massachusetts State Board of Agriculture on the work of extermination of the Gypsy Moth for 1893 has just been received. It comprises the report of the committee of the Board in charge of the work, the report of the director of field work, and the report of the entomological adviser, Prof. C. H. Fernald. The legislature of Massachusetts appropriated $100,000 for the campaign against this insect in 1893, which, with about $5,000 left from the appropriation of the previous year, gave a fund of $105,000 for the year's work. Of this sum $75,927.46 was expended, the largest items being $56,874.33 for wages of men and $10,047.78 for supplies, tools, and insecticides. For the year 1894 an appropriation of $165,000 is asked. These figures indicate the extent of the task which the State of Massachusetts has to perform, and the importance of performing it successfully is shown by Prof. Fernald's estimate of $1,000,000 as the probable annual damage which the Gypsy Moth would do in Massachusetts alone if allowed to spread.

The work has been directed mainly toward checking the spread of the insect over adjacent territory. In this the committee and its director of field work, Mr. E. H. Forbush, seem to have been fairly successful, a list of ten places being given from which the insect has apparently been exterminated, while a large number of near-by towns in Massachusetts, Maine, and New Hampshire have been carefully inspected.

It is contended that the work still to be done demands even larger appropriations, and the list of towns still infested by the insect includes the city of Boston and twenty-one of the smaller suburban towns immediately around it. Some 12,000 acres of woodland are comprised within this territory.

Spraying with arsenicals, according to Mr. Forbush's report, was only partially effective, and such was the prejudice prevailing against this method in some of the infested towns that people frequently washed the trees and shrubbery with water from the garden hose, and so neutralized the effect of the spraying. Banding the trees with insect lime was also not thoroughly effective in preventing the caterpillars from ascending the trees, and while burlap bands afforded a means of assembling the insects, so that they could be easily killed, this method of trapping is completely successful only when the bands are visited every day—an impossibility with the means at command over so large a territory. Two means accomplished the object sought whenever they could be thoroughly applied. Fire can be used to destroy the eggs of the moth, to kill the caterpillars, or to starve them

by burning all near-by vegetation on which they feed; but this method is feasible only on waste lands. "A thorough, scientifically conducted search for and destruction of eggs, supplemented by burlapping and hand-killing, is the only method yet known that can be implicitly relied upon to secure extermination where fire can not be used."

Mr. Forbush is of the opinion that "If all trees and plants in and near each isolated moth colony could be sprayed with an insecticide which would surely and quickly kill all feeding caterpillars without injury to the foliage it would be the best plan to pursue in the towns least infested. Such an insecticide seems to have been found." This is presumably the mixture referred to upon page 20 of the report as "an arsenite with acetate of lead and glucose in water," the formula being: Sodic arseniate, 29.93 per cent; plumbic acetate, 70.07 per cent. This mixture, it is stated, has given the best results yet obtained by spraying.

Professor Fernald's portion of the report is brief, and consists chiefly of quotations from Professors Packard, Weed, Fernald, Smith, and Lintner commendatory of the work done by the committee. Two more parasites, *Pimpla pedalis* and *P. tenuicornis*, the first omitted from the list of last year and the second bred from the Gypsy Moth this year (1893), are added to the previously known parasites, making eleven true parasites which live within the caterpillar, but which do not emerge until after it changes to a pupa and is dead.

THE MEMBRACIDÆ OF NORTH AMERICA.

In the Bulletin of the Illinois State Laboratory of Natural History, current volume (pp. 391–482), Dr. F. W. Goding publishes a bibliographical and synonymical catalogue of the described Membracidæ of North America. The catalogue is well arranged and well printed. Localities are given with care, but food-plants are omitted except in a very few cases. The author introduces somewhat of an innovation by describing new forms in their catalogue position. In this way he prints descriptions of two new genera and sixteen new species. There are catalogued altogether 278 species, distributed among 65 genera. We are pleased to see the check-list idea giving way before these bibliographical and synonymical catalogues in comparatively new groups. The extra labor involved on the part of the compiler is much more than compensated for by the usefulness of the completed work. A thoroughly careful catalogue of this sort implies extended systematic work and indicates the near appearance of a monograph.

THE CACAO BUG OF JAVA.

We have recently received from Mr. A. King, manager of the cacao estate "Aardenburg," Java, owned by Mr. P. Maclaine Pont, of The Hague, specimens of an insect which does much harm to cacao, tea, and

cinchona in Java and Ceylon. Mr. King states that the adult insects fly and touch nearly every branch of a tree, after which the branches turn black, wither, dry up, and fall off. It is his opinion that the insects lay their eggs in the branches and multiply there. Their offspring are little brown insects which do not fly, but mostly injure the fruit. All efforts to destroy them have failed. The insect proves to be *Heliopeltis bradyi* Waterhouse, but careful examination of the branches, leaves, and fruit-husks failed to show any trace of the egg. Eggs were, however, taken from the body of one of the females and were very slender, about 1.4^{mm} long by 0.2^{mm} in diameter, and having a threadlike appendage of about 0.6^{mm} in length. According to the observations of Mr. J. Wood-Mason, of Calcutta, published in 1884, the eggs of *H. theivora* are laid singly in the substance of the tenderest shoots of the tea plant, in the internodes or portions of the stem between the pepoe and the two or three leaves succeeding from above downwards, and in the buds developed in the axils of the plucked leaves and in the parts thereto; that the presence and position of each egg is from the first indicated on the exterior by two unequally long glistening, bristle-like prolongations of the shell and later by discoloration of the pierced point. While the blasting of the tender twigs so characteristic of the work of this insect is largely accomplished by this process of egg-laying, it is also brought about by the puncturing of the stem by the beak of the insect in the process of obtaining food. Therefore the mere fact that the twig is blasted does not necessarily mean that it contains eggs, and at the wrong time of the season much labor might be wasted by the plucking and burning of the blasted twigs, as recommended by Mr. Wood-Mason and one or two other Ceylonese and Indian writers. The point is to ascertain the time of year (if there is a definite and restricted time of the year) when oviposition normally takes place. If the plantation is small, hand-picking of blasted twigs might accomplish some result. A much better plan, in our opinion, however, will be to await the hatching of the bulk of the eggs and at that time to apply a kerosene emulsion spray in order to kill the young bugs before they have acquired wings.

BED-BUGS AND RED ANTS.

It will be remembered that in our article on this subject in volume II of INSECT LIFE we explained the propriety of considering these two insects together, on the ground that the red ant nuisance is mitigated by the fact that these insects kill bed-bugs. We had never seen this statement in print before, and are consequently pleased to see published testimony of the fact from Mr. F. C. M. Boggess in the *Farmer and Fruit Grower* (Florida) for February 10. The habit is so well known to Mr. Boggess that he heartily recommends the introduction of red ants into houses for the purpose of exterminating bed-bugs. He advises the owners of infested establishments to place a piece of meat in an

old tin can, and bury it in the ants' nest, afterward taking it into the house and placing it beside the bed. Then he recommends that a bug or two be hunted up and placed in the can in order, as it were, to rouse a slumbering appetite for bugs in the ants. After that, he remarks, there is great satisfaction and much sport in seeing the ants run the bugs down and dismember them.

NORTHWARD RANGE OF THE WHEEL BUG.

Through the kindness of Mr. W. B. Sargent, of New York, we have received two specimens of *Prionidus cristatus* which were taken on the stone wall of Sleepy Hollow Cemetery at Tarrytown-on-the-Hudson, N. Y. This is most northerly point from which we have received this insect and we shall be glad to hear from readers who have found it farther north.

NORTH AMERICAN TRYPETIDÆ.

Mr. William A. Snow, in the *Kansas University Quarterly* (vol. II, No. 3, 1894), publishes a careful paper upon the Trypetidæ in the Museum of the University of Kansas. He gives descriptive notes indicating variations among the described species and characterizes 14 new species and two new genera. Two excellent plates showing wing characters of twenty-four forms are given.

THE ORANGE FLY IN MALTA.

In our article on the Morelos Orange Fruit-worm, in INSECT LIFE, (vol. I, p. 45,) and that on a Peach Pest in Bermuda (vol. III, p. 5), we have referred to the damage done in Mediterranean countries to Citrus and other fruits by *Ceratitis capitata*. In the December (1893) number of the *Mediterranean Naturalist* there is a short review of a pamphlet published in the Maltese dialect by Prof. N. Tagliaferro, at the expense of the Agricultural Society of Malta, and which gives a popular exposition of the life and habits of the insect and some consideration of the available remedies. He insists on the necessity of the gathering of all rotten fruit which has fallen to the ground, and proposes a means of his own discovery for considerably diminishing the damage. In October he smears with honey a few oranges on each tree. The adult flies gathered quickly around the honey and were readily captured. This remedy will be of some use where a few trees are to be protected and suggests the advisability of experimentation on a large scale.

LOCUSTS AND COCKROACHES OF INDIANA.

Mr. W. S. Blatchley has favored us with an important paper entitled "The Locustidæ and Blattidæ of Indiana," extracted from the Proceedings of the Indiana Academy of Sciences for 1892. These groups have been but little studied in the United States, and the consideration

of even local fauna will be of value in many parts of the country. In the Locustidæ Mr. Blatchley describes 39 species, and his descriptions are so full and careful that by their use identification will be easy. He follows with the record of 12 species whose distribution is such that they will probably be found in future in Indiana. Under the head of the Blattidæ he describes with equal care seven species, five of which are indigenous.

CATALOGUE OF THE DRAGON-FLIES.

Mr. P. P. Calvert's Odonata of the Vicinity of Philadelphia, with an introduction on the study of this group of insects, extracted from the Transactions of the American Entomological Society (vol. xx, pp. 150 a–272), is a pamphlet which should be in the hands of all general collectors of insects. The handsome and interesting group of Dragon-flies has been neglected by students of American entomology, largely for the reason that such a publication has been lacking. The paper is evidently prepared with great care.

LIFE-HISTORY OF THE CHICKEN DERMANYSSUS.

An inquiry from Prof. F. L. Washburn, Entomologist to the State Experiment Station, Corvallis, Oreg., has reminded us that the life history of *Dermanyssus gallinæ* is not well known. This species is now comparatively common in certain sections of this country and its life affords a field for investigation.

Its larva is hexapodous. The adult mite is egg-shaped, posterior end largest, and is slightly flattened; the abdomen is margined with short bristles; the color varies from yellowish to dark red, depending on whether it is in a fasting condition or charged with blood. The oviparous female is .70^{mm} long by .40^{mm} broad. The male is .60^{mm} by .32^{mm}. It infests domestic birds, poultry, etc., and also wild birds which nest about barns and outhouses, such as swallows. When abundant it also attacks horses and other mammals, producing a sort of scabies. A peculiarity of the habits of this insect is that its attacks are always temporary, or practically so, in that it abandons its host during the daytime and conceals itself about the premises in which the animals are kept. In the case of poultry it collects in colonies of males, females, and nymphs on the roosts, and frequently in the case of horses remains in the blankets or about the stalls. In poultry the attacks are severe and result in consumption and death. The mite is very prolific, multiplying quickly, although the exact period is not mentioned. The remedies consist in the removal of all poultry from stables and barns and the destruction of all nests of swallows, pigeons, etc. The treatment of poultry houses consists in the application of oils or other well-known insecticides adapted for such purposes.

AMERICAN TERTIARY APHIDIDÆ.

Mr. S. H. Scudder has sent to his correspondents, as an extract from the thirteenth annual report of the U. S. Geological Survey, a pamphlet comprising some account of the Tertiary Aphididæ of North America. It is astonishing that these soft-bodied and delicate-winged insects should be preserved in the rocks, yet Mr. Scudder has seen, from the Florissant beds alone, 107 specimens. The American forms comprise 32 species, divided into 15 genera, while in Europe but 19 nominal species are known. There seems to be an extraordinary variation in the wing-neuration of these fossil species, which necessitates a large number of genera. Most of them fall into the sub-family Aphidinæ, only a few of them being placed in the Schizoneurinæ. The genera and species receive treatment by means of synoptical tables, and bibliographical references are given, many of the forms being shown in careful plates illustrating the fossils exactly as found and also reconstructions of the wings.

THE CARNATION TWITTER.

In response to our inquiry requesting information about this disease of the Carnation, published on page 45 of the current volume of INSECT LIFE, Mr. William Falconer, editor of *Gardening*, writes us that the insect which troubled Mrs. Thaxter's plants is plainly not the one which produces the condition known as "twitter" and concerning which we quoted an item from Peter Henderson's late handbook. Twitters, says Mr. Falconer, is caused by what is probably a true Thrips. The most active ones are yellow and the more mature ones, apparently, are black. Tobacco smoke, he says, will kill them, but the plants must be brought into the greenhouse or into a pit to be fumigated, and the fumigation will have to be repeated several evenings in succession to be effective. For outdoor work he recommends mulching with fresh tobacco stems and dusting fresh tobacco dust or snuff upon the dew-moistened plants.

It will be remembered that the insect which attacked Mrs. Thaxter's carnations was an Anthomyiid larva, as determined by specimens which she sent to the Division, and our query has called forth a card from our English friend and correspondent, Mr. R. McLachlan, who reminds us that he published on page 135 of the *Entomologists' Monthly Magazine* for May, 1892, a little note concerning a similar damage to Carnations and Picotees in London. Anthomyiid larvæ are there described as living beneath the rosette of leaves forming the crown of the plant and also as boring into the stem below the crown, in some instances causing the crown to drop off. The perfect insect was determined as *Hylemyia nigrescens* Rnd. It is nearly allied to *H. cardui*, which feeds in the flower heads of thistles. Mr. McLachlan writes us,

however, that he suspects that more than one species of Anthomyiid is concerned in this work.

The rearing of the adult insect which does this damage at the Isle of Shoals becomes, therefore, of considerable interest, since *H. nigrescens* Rnd. does not occur in this country. It may turn out to be one of our native species, or it is possible that it has been imported from England, perhaps by way of Canada. No remedy beyond burning the infested plants with the contained larvæ has been suggested.

APPLICATION OF SULPHUR FOR THE RED SPIDER.

At the February 8, 1894, meeting of the California State Horticultural Society Mr. Alexander Craw read an interesting paper upon the Red Spider in which he announced that Mr. George Ditzler, of Biggs, Butte County, Cal., has constructed a broad-cast seeder in such a way that it distributes sulphur in a dense cloud over from three to six rows of trees in the time necessary to drive through. The sulphur is thrown in one direction and is applied in the morning when the leaves are damp. An almond orchard treated in this way for two seasons retained its leaves until late in the fall, whereas other orchards in the same district not treated dropped their leaves in August and September.

RUSSET ORANGES.

A little item in the New York *Confectioners' Journal*, in which golden russets and small dark russets are incidentally stated to be the best keeping oranges, has called to our mind a very general experience which we have never seen referred to in print. We buy for our own table consumption russet oranges in preference to bright oranges, and yet in our official work we are in constant receipt of requests from orange-growers for methods of destroying the Rust Mite. The hardening of the skin of the orange from the work of the Rust Mite undoubtedly keeps them juicy, improves them for shipment, and retards decay. The selection of bright oranges was a fad among growers and wholesale buyers which did not last. The time has come when russet oranges for shipment command higher prices and when remedial treatment for the Rust Mite is only necessary for a great excess of this Acarid. The change in public opinion in this matter shows that utility governs even sentiment.

DOES THE HORN FLY ATTACK HORSES?

In our experience with the Horn Fly we have never known it to injure anything but cattle. We have several times met stock-raisers who believe that they have seen it attacking horses, and Mr. J. S. Johnson, of Cheyenne Wells., Colo., writes us under date of February 27 that he found this species in numbers upon a three-year old horse in Cheyenne. Have other correspondents observed similar cases?

A LEGAL CASE IN CALIFORNIA.

An interesting case has just been tried in the courts in Los Angeles, Cal. A nurseryman named Cunningham brought 400 lemon trees to Los Angeles some time ago and they were found to be infested with Black Scale. The county officers notified Mr. Cunningham that they would have to be fumigated, and he told them he would be glad to have them do the work. One of the officers, Mr. McMullin, then fumigated the stock in the car in which it was shipped. Upon subsequent planting, some of the trees died back, and the nurseryman claimed damages. The matter was submitted to arbitration, and Mr. Cunningham, not being satisfied with the result, brought suit against John Scott, horticultural commissioner, and his assistant, Mr. McMullin, for damages. The case was decided in favor of the defendants, the judge holding that Mr. McMullin had exercised the usual precautions, that he was a competent individual, and that the damage to the stock was not the result of negligence or lack of information on his part. The damage resulted, in all probability, from the fact that the strength of the cyanide differs in different packages, and even in different parts of the same package. It was shown that the most careful men sometimes fail to fumigate without injury, and in this case the plaintiff was held to have assumed the risks inherent in the process itself. The law requiring fumigation is in the nature of a police regulation, in the enforcement of which it often happens that some individuals must suffer loss, because the law is general and can not be modified to suit particular cases.

CORRECTIONS.

By inadvertence, on page 295 of volume V, INSECT LIFE, we referred to Mr. O. E. Janson, the well-known natural history agent and bookseller of London, England, as "the late O. E. Janson." We had somehow received the impression that Mr. Janson was deceased, but we have had the best assurance from him since, that he is still in the flesh, and we hope he may remain so for many years to come.

"The last paragraph of my paper on 'Arsenical Spraying of Fruit Trees while in Blossom,' as published in the current volume of INSECT LIFE (pp. 181–185), should read as follows:

It is therefore respectfully submitted whether there should be the intermission of spraying as proposed, urged, and sought to be made compulsory through legislation, until it shall appear beyond all controversy that the interests of the apiarist and the fruit-grower, each carefully considered and perhaps weighed one against the other, really demand it.

"The substitution of agriculturist for 'apiarist' in the paper as printed had entirely hidden a point that I desired to make."—[J. A. LINTNER.]

"Prof. E. G. Lodeman writes me that I misquoted him on p. 120, line 6, of the present volume of INSECT LIFE. Both London purple and Paris green were used in Prof. Lodeman's experiments, but it was only the Paris green that he found to possess the fungicidal properties."—[C. P. GILLETTE.]

THE PHYLLOXERA IN TURKEY.

It is not in our country alone, says *La Nature* for January 6, 1894, that the Phylloxera is a scourge. For twelve years or more it has ravaged the Asiatic coast of the Bosphorus, the territory invaded comprising more than 2,000 hectares, in 800 hectares of which the vines are completely destroyed. Within the last two years the disease has also appeared on the European side, where three hectares out of 2,500 have been attacked, and one hectare has been completely stripped. On the Bosphorus the disease has attacked at Therapia more than forty hectares, half of which is almost completely ravaged.

It has been noticed that in the environs of Constantinople the progress of the disease has been rather slow. This peculiarity is due to the fact that the vines of this region are planted at a depth of one meter. Their roots, thus attaining large dimensions underground, offer more resistance to the malady and delay its progress.

No preventive treatment has so far been employed in combatting the Phylloxera. The Ottoman Government has contented itself with establishing two nurseries of American vines, which distribute American cuttings gratuitously to viticulturists. In the last two years 200,000 of these cuttings have thus been distributed. The nurseries and the school of grafting are under the direction of M. Eckerlin, while the inspection of these establishments is confided to a graduate of the school of Grignon, Agathon Effendi, inspector of viticulture. The results so far obtained are very satisfactory, and permit the hope that it will be possible to regenerate the destroyed vineyards.

Except the Phylloxera law of April 2-14, 1880, which is still in force, no legislation has been adopted in Turkey against the disease.

In consequence of the appearance of the Phylloxera in the environs of Constantinople, notably on the Asiatic side, new plantations of vines have been made in lands of that vicinity formerly employed in different cultures, to replace the vineyards which have become unproductive. The area of these new vineyards is actually greater than that of the vineyards injured or destroyed, so that the production of grapes has remained the same and the price has not advanced.

The culture of the vine was formerly very prosperous in the province of Trebizonde, and was a source of wealth to the inhabitants; but it has been abandoned for forty years or more.

SPECIAL NOTES.

Change in the Office of Chief of the Division of Entomology.—Readers of INSECT LIFE have probably already been made aware, by notices in the agricultural and other papers, of the fact that on June 1 Prof. Riley, who for more than thirteen years has held the position of Chief of this Division, resigned, largely on account of poor health and the wishes of his family. The honorable Secretary of Agriculture, following civil-service principles, has appointed the writer to the position thus made vacant. The present number of INSECT LIFE will be the last one published under the joint editorship of Prof. Riley and the writer, and will complete volume VI. The first number of a new volume will follow almost immediately. Those readers who have found something of interest in the pages of the six volumes published under the joint editorship will have frequent occasion to regret that the well-stored mind and guiding hand of the justly eminent ex-chief of the Division will no longer conduct the publication, but no one will feel the lack more deeply than the writer, who, through long years of association, had learned to appreciate as perhaps no one else could the great scientific acumen and unequaled supply of entomological knowledge possessed by Prof. Riley.—L. O. H.

The Periodical Cicada.—As is well known to readers of INSECT LIFE, Broods XII and XVIII of the Periodical Cicada appeared in different parts of the Southern and Eastern States the present season. By a thorough circularizing of the region in which the insects appeared, the Division is in possession of a large amount of information bearing upon these two broods, the region hitherto mapped having been somewhat extended in certain directions, while some of the old localities have failed of verification.

The Fluted Scale in Florida.—Many times during the past ten years we have received specimens of different scale-insects from Florida, perhaps most frequently the Florida Wax Scale (*Ceroplastes*

floridensis), with the question, "Is this the Fluted Scale or White Scale of California?" and we have referred to a number of these sendings in the early volumes of INSECT LIFE. Up to the end of May *Icerya purchasi* had not been found in the United States east of the Rocky Mountains. On the 2d of June, however, we received undoubted specimens of this insect from a large orange-grower in Hillsboro County, Fla. He wrote that upon the 26th of May he found the insects very thick upon two small trees. Their abundance upon these trees would seem to indicate that the species will thrive perfectly well in the climate of Florida, and unless active remedial measures are at once taken, the orange-growing industry in Florida is threatened with great damage. We have advised the gentleman mentioned concerning the best remedies, and the matter will be investigated by an agent of the Division, who has gone to Florida. From the present outlook it seems as though it will not be difficult to stamp the insect out, and the introduction of the celebrated *Vedalia cardinalis* into Florida will probably not be necessary.

Recent Publications of the Division.—In the pursuance of a scheme by which a number of the most important of the insect enemies of crops will be treated of in circular form, for use in correspondence in case of emergency, Circular No. 4, new series, of the Division, treating of the Army Worm, was published early in June. This insect was treated in advance of others of quite as great importance on account of the fact that the present is an Army Worm season in many of the eastern States. These circulars are to be brief and well illustrated, and are to contain a short summary of the life-history of the particular insect or insects under consideration, together with a full account of the remedies advised.

Farmers' Bulletin No. 19, of the general series of the Department, is entitled "Important Insecticides: Directions for their Preparation and Use." The bulletin was written by Mr. Marlatt and contains in 18 pages a full but compact account of the preparation and means of application of the most important insecticides which are recommended by the Division.

Bulletin 32, now in press, contains the reports of the field agents of the Division for 1893. It is a continuation of a series of these reports, the previous numbers being Bulletins 30, 26, 23, and 22.

New Edition of Hubbard's "Insects Affecting the Orange."—The edition of the report on the insects affecting the Orange by Mr. H. G. Hubbard, which was published in 1885, was exhausted within a year or two, so great was the demand from orange-growers for information of this character. Mr. Hubbard resigned his commission under the Division

after the completion of his report, and press of other work has prevented the publication of a revised edition up to the present time. The Department has been fortunate the present summer in being able to reëmploy the author of the report, and his first task will be a careful revision of his old work, so that a new edition, brought down to date, will be published before the close of the year.

Investigations of the Cause of Potato Scab and Potato Rot.—At the celebration of the completion of the West Virginia Experiment Station building at Morgantown, April 6, 1894, Mr. A. D. Hopkins, Entomologist to the Station, presented a somewhat exhaustive paper on the relation of certain Dipterous larvæ of the family Mycetophilidæ to the so-called potato scab and potato rot. As the result of extensive investigations begun in the fall of 1891 and continued up to date, Mr. Hopkins concludes that a large percentage of the damage to potato tubers in West Virginia heretofore attributed to the potato scab fungus, *Oöspora scabies* Thaxter, and to the potato-rot fungus, *Phytophthora infestans*, is caused both directly and indirectly by certain of these fungus gnats. He also believes that the attacks of the same insects are the primary cause of most forms of potato scab which are real detriments to the tubers. One of the forms more especially instrumental in producing the injurious condition referred to is an undescribed species to which Mr. Hopkins has given the MS. name *Epidapus scabies* and the common name, Potato-scab Gnat. He has ascertained that the fungus gnats which induce certain forms of potato scab breed commonly in soils containing decaying vegetable matter, animal manures, and similar substances; that lime and ashes offer favorable conditions for their increase, in promoting decomposition of vegetable matter and moisture and in presenting unfavorable conditions for the presence of insect enemies. Dry or sandy soil free from vegetable matter presents unfavorable conditions for the development of the gnats. The use of scabby seed potatoes offers favorable conditions for the attack of the insects, as these are attracted to the scabby spots, in which they breed, and are thus brought into contact with the growing tubers. Mr. Hopkins recommends soaking the seed potatoes in a solution of corrosive sublimate previous to planting. Fortunately the preventive measures found to be most effective against the scab fungus are equally applicable in the prevention of the attack and injury of the fungus gnats.

BEES.*

By C. V. Riley.

Living in such well-organized communities, exhibiting so much intelligence, and yielding one of the most delicious sweets known, the Honey, or Hive Bee has attracted attention from the earliest times, and ever since Aristotle, Virgil, and Columella told what was then known of this industrious insect, it has been the subject of investigation. Honey and wax were far more important to man in olden time than they are to us who have so many substitutes for them, and the ancients gave much attention of the practical kind to bees. How very little they knew, however, of their true economy is shown by the prevalence of the belief that bees came from the carcasses of animals. This superstition as to the *Bugonia*, as exemplified in the biblical story of Samson (Judges XIV, 8), continued for twenty centuries, and grew out of the resemblance to the Hive Bee of *Eristalis tenax*, a Dipterous fly which breeds in putrescent matter. This fact, first clearly recognized by that excellent observer, Réaumur, has been fully established in a recent most interesting paper by Osten Sacken "On the so-called *Bugonia* of the ancients, and its relations to *Eristalis tenax*." (Bullettino della Società Entomologica Italiana, Anno XXV, 1893.) In fact the fabulous about bees prevailed till the beginning of the last century, when Maraldi, by the invention of glass hives, gave an impetus to correct observation, and led to the remarkable memoirs of Swammerdam, Réaumur, Schirach, and Francis Huber.

The fact that the Hive Bee can be cultivated and controlled with a view to profitable industry has served to heighten the interest in it, and since the invention in this country, in 1852, of the movable frame hive, by a retired clergyman, the Rev. L. L. Langstroth, progress in apiculture has been rapid and continuous. Of the more important subsequent inventions, many of them made in Europe but perfected in America, may be mentioned the honey-extractor, which, by centrifugal force, throws the honey from the comb, leaving the latter intact and ready to be used again; and the comb foundation, by which sheets of wax are impressed with the bases of the cells and employed to insure straight and regular combs, to limit drone production and increase the honey product. With the bee-smoker in its modern form, bees are also much more easily controlled and manipulated than formerly. Much

* From an address on Social Insects, as President of the Biological Society of Washington, delivered in the hall of Columbian University, January 29, 1894.

has been done, also, in ameliorating the races of bees, both by introducing races from other countries and by the crossing of these. There are some three hundred thousand of our citizens engaged in bee culture, and they add over twenty million dollars annually to the wealth of the country in honey and wax. This amount may be, and in the near future doubtless will be, very largely increased. It is, in fact, difficult to realize what an immense amount of honey is wasted from lack of bees to garner it, and the poet Gray would seem to have had his own ideas on the subject when he wrote the familiar lines:

> Full many a flower is born to blush unseen,
> And waste its sweetness on the desert air.

The service directly rendered to man by bees, however, in supplying the products mentioned, is but slight as compared with the service indirectly rendered by cross-fertilization of our cultivated plants, and it has been estimated that the annual addition to our wealth by bees in this direction alone far exceeds that derived from honey and wax. One of the latest discoveries bearing on this subject, very fully enforcing the general principle, was presented to the Society for the first time within the past year by our fellow-member, Mr. M. B. Waite, as a result of his investigations for the Division of Vegetable Pathology in the Department of Agriculture. He has proved that a majority of the more valued varieties of our apples and pears are nearly or wholly sterile when fertilized by pollen of the same variety, or that they bear fruit of an inferior character and very different from that produced when cross-fertilized; further, that were it not for the cross-fertilizing agency of bees, scarcely any of these fruits could be produced in the abundance and perfection in which we now get them, and that to secure the best results and facilitate the work of the bees, it is yet necessary, in the large majority of cases, to mix varieties in the same orchard. Bees were doubtless the earliest embalmers, since they use the propolis to encase, and thus prevent the putrefaction of any intruder which is too large for them to drag out of the hive.

There is much, even to-day, in the economy of the Hive Bee that is yet debated among the best informed apiarians, but I will endeavor to give you an epitome of what is absolutely known of its more important habits, structures, and functions—the true life-history, so to speak, of the bee. By going somewhat into detail with this species, we may avoid repetition in treating of the other social Hymenoptera, all of which have somewhat similar larvæ and transformations. Let us, in imagination, proceed to an ordinary well-kept apiary. Taking a bee-smoker in one hand—one of the pattern invented by the late M. Quinby, of New York—we lift one corner of the hive cover or quilt and send enough smoke down among the bees to give them to understand that they must submit to our manipulation. Drawing out one of the brood combs, which is rendered easy by the movable frames, thousands of the bees are seen adhering to the surface of the comb. They are mostly

workers, but in summer there may be seen numbers of stouter-bodied bees, which are the drones or males. If the bees have not been too much disturbed by the smoke or the removal of the comb, the queen may be seen walking slowly over the surface, surrounded by the workers, who, in deference, recede as she walks along, turning their heads toward her and advancing so as to touch her body with their antennæ. It was long thought that the queen exercises sovereign powers, and Shakespeare voices the popular opinion when, in Henry V, he says:

They have a king and officers of sorts.

One of the earliest definitions of a queen bee in Webster's dictionary was, "The sovereign of a swarm of bees." In reality, however, the government of the hive is purely democratic. Each works for the common welfare, and only so long as the individual, whether queen, drone, or worker, is useful to the community, is it spared. With the exception of the drones, the queen is the only bee in the hive having the reproductive organs fully developed, and she is, therefore, the mother of the colony. During the more prolific season she lays two or three eggs in the course of a minute, and often as many as four thousand in twenty-four hours. Three days after deposition of the egg the young larva is hatched. It is the office of the younger worker, known as nurse-bees, to furnish these young larvæ with food, which they are assiduous in doing. In the case of the worker larvæ, five days suffice for full growth, when they nearly fill the cells. As with most other soft-bodied larvæ that are imbedded in a semiliquid nutritious medium, we find provision to prevent contamination of the environmental food with excrementitious matter. The food supply is, in the first place, highly nutritious, and nearly all capable of assimilation. Lest, however, any portion of the waste should enter the food, the larva is, according to Cheshire, rendered incapable of voiding anything during the time of feeding. The arrested development of the digestive system leaves the posterior inflection, which corresponds with the after bowel, unconnected with the middle bowel, and the slight accumulation of waste matter in this latter is cast into the base of the cell at the last molt, and is covered in the bottom of the cell by the lower part of the last cast skin or pellicle, which also serves to line the rest of the cell and leave it clean for the formation of the pupa. Thus, when the young bee emerges the cell needs but to be brushed out by the workers to be ready to receive another egg, or stores of honey and pollen which are to form the winter food.

Just before pupation, or when the larva has acquired full growth, the adult workers cover the cell with a convex lid, composed, not of wax alone, as in the case of the cappings of honey cells, but of pollen and wax combined. The larva just before pupation strengthens this cap by lining it with silk, which is also slightly attached to the last cast skin. The pupa state lasts some twelve days, and on the twenty-first day from the time the egg was laid the perfect bee cuts a circular open-

ing in the cell cap and makes its way out. The first care of this young bee is to seek food from an open honey cell, and in the course of two or more days it has acquired sufficient strength and consistence to enable it to begin its labors as a nurse bee, doing for the developing larvæ what was so recently done for it. After a week's time it takes short flights, noting well the location of its hive, so as to be able to return to it.

Queens are bred only when a colony is about to swarm, or when an aged or failing queen needs replacing, or where an accident has deprived the hive of her services. If she be removed from the hive during the working season, the bees are thrown into great excitement, shown by the change of the contented hum into one of alarm, by the hurried movements from the combs to the entrance, and by the discontented flight to and from the hive. If all the brood combs are removed the bees become panic-stricken and give utterance to a peculiar mournful note or distressed wail, quite different from the normal cheerful hum. In time, however, this excitement subsides, as they become satisfied of their loss. If the queen be returned, or the comb containing young larvæ be introduced into the hive, the whole attitude changes. The moment the first bee touches with its antennæ the queen, or a comb, or any point over which she had walked recently, it sets up a loud and cheerful hum, and the occupants of the hive, even those unable to see the comb, immediately catch the sound and crowd toward the point whence it first proceeded, repeating the jubilant note. If only a comb of larvæ be given them, they still recognize it as a deliverance from the threatened extinction of the colony. In a few hours one of the cells over a larva two or three days old will be enlarged by the partial destruction of the walls of the adjoining cells. This enlarged cell is built outward and downward, and the larva is fed on the so-called royal jelly or bee-milk. The supply of this food is always plentiful, and when a well-developed queen has issued it is not uncommon to find a quantity of the food in a partially dried, jelly-like mass in the bottom of the cell. When, preparatory to swarming, young queens are being reared, the workers have to guard them, even in the cell, from the jealous fury of the reigning queen, and the instinctive rivalry and conflict between queens, accompanied by a peculiar shrill battle cry, first noticed by the elder Huber, are quite suggestive of similar conflicts between rival queens in human monarchies.

ECONOMY OF HIVE—SOCIAL ORGANIZATION—DIVISION OF LABOR.

Each bee, as already stated, labors for the good of the commonwealth of which it is a member. Of them it might well be said:

Salus rei publicæ suprema lex.

It is the welfare of the colony which directs the actions of all, and not the will of the queen. Indeed, it would seem that the latter performs her important function—that of supplying the hive with eggs—

only when the workers will it, their own condition of prosperity as regards stores, or their anticipations of the future needs of the colony as regards population, causing them to supply the queen liberally with food rich in nitrogen—a partially digested substance, or a gland product, or perhaps a mixture of both, which she alone can not produce, yet without which any considerable production of eggs is an impossibility.

As Evans remarks:

> The prescient female rears her tender brood
> In strict proportion to the hoarded food.

We must, then, credit the industrious and provident workers with the chief influence in shaping the policy of the hive. They are the *servum pecus*—the living force—of the colony. And to the end that order and efficiency of effort may prevail, they have, we find, a marked division of labor. In the normal condition of the hive the young workers, as already stated, care for the brood—a labor which they take upon themselves within two or three days after issuing from the cell. The glands which secrete a part of the food required by the developing larvæ are active during the earlier part of the life of a worker. Later, these nurses become incapable of doing their work well as the gland system becomes atrophied. When a few days old they take short flights, if the weather favors, but seldom commence gathering stores before they are fifteen days old. Wax production is more essentially a function of the workers in middle life, and it is particularly noticeable that those bees fashioning the wax into combs are principally of this class. Many of those acting as foragers do, however, secrete wax scales, which are doubtless, in the main, utilized. Among the outside workers and hive-defenders some bring honey only on certain trips or for a time, others honey and pollen, others water, and yet others propolis or bee glue to stop up crevices and glue things fast. Meanwhile some are buzzing their wings at the entrance to ventilate the hive, and others are removing dead bees, dust, or loose fibers of wood from the inside of the hive or from near the entrance, or are guarding this last against intruders, or perhaps driving out the drones when these are no longer needed.

SWARMING.

Perhaps there is no action on the part of the Hive Bee which more distinctly indicates its intelligence and power of communication than the act of swarming. The fact that queen brood is being reared in the hive is the best evidence that the colony is preparing for flight or swarming; but in addition, it is noticeable that on the day of swarming the whole colony is excited, and in a measure has abandoned ordinary duties. For days previous to the event, scouts have been searching for a favorable hollow or crevice or place in which to house the new colony, and when the time finally comes, which is usually in the hotter part of the day, all the individuals of the hive leave after the

peculiar preparatory flight around the hive, known as swarming. The impulse to leave is such that many individuals not yet capable of flight fall to the ground, and the hive is practically abandoned by all those within it at the time of swarming. Individuals alight on some bough or object near by, with a view primarily to organization and the sending out and return of additional scouts. During this period a cluster will remain more or less in repose, but when once the location for a permanent dwelling has been finally determined upon, the whole mass will leave as with one impulse and fly swiftly and directly to the new home. With the first swarm that the new colony sends out it is the old or fertile queen that goes with the new swarm, but with the after swarms, which issue in about a week, it is a virgin queen that accompanies. The old colony begins again with the few individuals unable to follow the departing swarm, and which have crept back to the old hive, with those which at the time of swarming were busy in the field, and with those which issue from the yet undeveloped brood.

It is a popular mistake to suppose that mating takes place during swarming. If a virgin queen goes with the swarm, she subsequently takes the nuptial flight from her new home. As she flies swiftly and strongly, only the strongest and most vigorous drones are able to mate with her, and there is every opportunity for cross-fertilization with drones from some other colony. It has also been noticed that drones have a way of congregating in some particular spot as though awaiting their chance of thus mating with the queen.

THE MORE IMPORTANT SPECIAL ORGANS.

The different structures and organs of the Hive Bee are most interesting, but I can allude only to a few of the more striking. The tongue is a very complex organ, fitted for obtaining minute quantities of nectar from the flowers that secrete it but sparingly, or to remove the same substance rapidly when found in abundance. The figure of the head and appendages will illustrate this organ in detail. We have the mandible, mostly used for cutting and molding the wax, the maxillæ with their palpi, the labium and labial palpi, and finally the ligula or true tongue with its spoonlike tip. This is extremely flexible, and consists of a rod or central portion, nearly surrounded by a sheath, which is covered thickly with hairs, which aid, by capillary attraction, in taking up the liquid food. A lapping motion, when the liquid is abundant, causes the liquid to be lodged among the hairs of the tongue, which can be partially drawn into the mentum, and from this point the maxillæ above and the labial palpi below unite to form a tube around it, which is closed above the extension of the epipharynx, and by alternately arching and depressing the maxillæ, the space inclosed is increased or decreased, thus producing suction and drawing the liquid held on the tongue into the opening of the esophagus.

When drawn from the flowers the nectar is thin and watery, and lacks the qualities of the delicious honey into which we find it converted when removed from the cells sealed by the bees. This watery substance is evaporated to the proper consistency in the heat of the hive and by currents of air passing over the surface of the combs before the cells are sealed, these currents being created by bees stationed at the entrance and buzzing incessantly. There has been much discussion among apiarians, as among writers, as to whether the bee gathers or makes honey. Strictly speaking, it does both. Formic acid is contained in the blood of the bee, and especially in the salivary glands, as recently demonstrated by von Planta, of Zurich, and when the gathered nectar, which easily ferments, is regurgitated from the first stomach into the cell, it is combined with sufficient formic acid to change the cane sugar into invert sugar (dextrose and levulose in equal proportions), while the evaporating process just described eliminates the superfluous water; so that honey which resists fermentation is essentially a made product.

I would also draw your attention to the wax-producing organs. (See Fig. 23.) If we examine the under side of the abdomen of the worker,

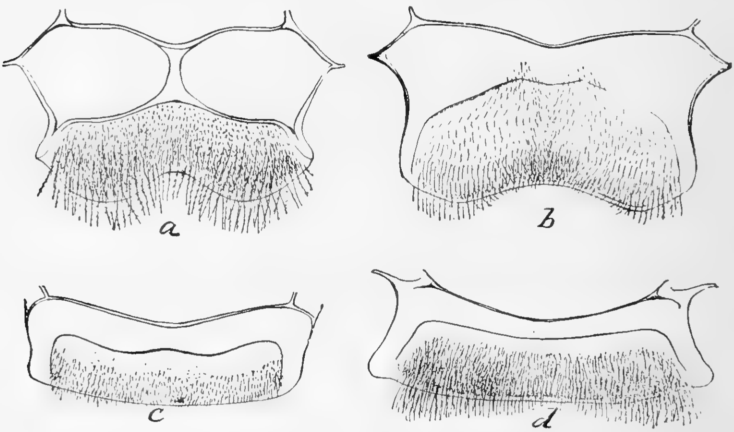

FIG. 23.—WAX DISCS OF SOCIAL BEES: *a*, Apis mellifica worker; *b*, A. mellifica queen; *c*, Melipona worker; *d*, Bombus worker—all enlarged. (From Riley.)

the exposed portion of each segment will be seen to be covered with a web of hairs, and, by elongating the abdomen, each segment, with the exception of the first and sixth, is seen to bear two shallow, irregularly shaped plates, one on each side of the median ridge, which is extended as a rim around the whole contour. These pale yellow, smooth plates are in reality wax molds, the wax glands being under the plates and the secreted wax reaching the surface by osmose through the thin membrane and hardening into a somewhat brittle scale, resembling in appearance a minute, nearly transparent fish scale. The wax is secreted under conditions of great heat, the bee ascending for this purpose to the top of the hive, and the wax producers consuming a large amount of honey.

The next structure of importance to which I would call your attention is the wax pincers (Fig. 24, A, *a*, *b*), which is a modified structure of the juncture of the tibia and metatarsus of the posterior legs. With these pincers the wax producer plucks a scale from one of its wax plates, passes it rapidly forward to the mouth, and here makes it plastic and at the same time more or less yellow, by continually manipulating and chewing it between the mandibles. Then the bee sticks it to the under surface of the hive cover or object to which the comb is to be attached. More wax is added, forming a slight ridge, which is chiseled or pressed from each side by workers, using their firm and highly polished maxillæ, and placing themselves so that their range of work will overlap just one-half. As this ridge is built down, forming a sheet—the septum upon which the cells are constructed—the sides of the latter are started simultaneously. In their efforts to make the cells concave at the bottom and so as to fit together at the sides without loss of material, mutual pressure results in straight lines, the sides

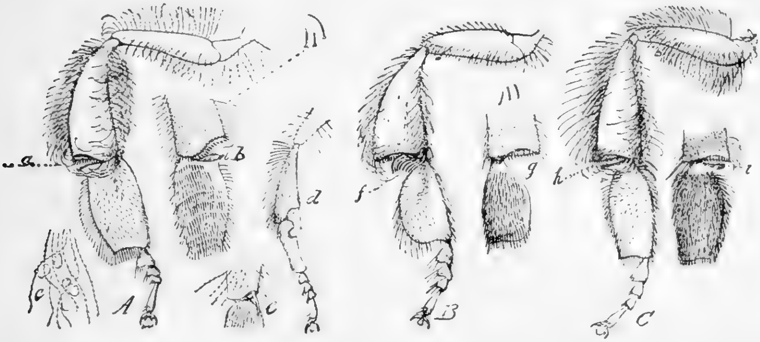

FIG. 24.—MODIFICATIONS OF THE HIND LEGS OF DIFFERENT BEES: A, *Apis*: *a*, wax cutter and outer view of leg; *b*, inner aspect of wax cutter and leg; *c*, compound hairs; *d*, anterior leg, showing antennal scraper. B, *Melipona*: *f*, peculiar group of spines at apex of tibia; *g*, inner aspect of wax cutters and first joint of tarsus. C, *Bombus*: *h*, wax cutter; *i*, inner view of same and first joint of tarsus—all enlarged. (From Riley.)

becoming hexagonal in outline, just as six soap bubbles resting against a seventh causes the latter to assume a hexagonal form; while the bee starting a cell on the bottom of one already commenced on the other side naturally takes the apex of the latter as a part of the boundary of its own cell in order that the latter may also be concave. Thus three rhomboidal faces forming the base of one cell form individually a part of each one of three cells on the opposite side.

Finally, I would call your attention to the arrangement of the hairs on the inside and outside of the legs (Fig. 24, A), so well fitted for collecting and holding pollen, and to what is known as the antennæ-comb or strigil (Fig. 24, *d*), a structure with which the bee cleanses itself, and especially the antennæ, which are organs of extreme sensibility and need to be kept well cleaned. This structure occurs on the under side of each front leg and is a semi-circular cavity in the upper end of the

metatarsus. The cavity is fringed with stiff hairs or spines, forming a comb. The distal or opposing end of the tibia is furnished with a spur, slightly concave on the inner surface and known as the velum. When the tibia and metatarsus are bent at right angles the velum falls over the cavity and forms an almost circular opening just large enough to snugly hold one antenna.

These are the more conspicuous structures, though there are others of minor importance, all indicating remarkable adaptation to special purposes and to the necessities of the bee.

The Hive Bee is but one of the many species of its family, and while representing the most highly organized of the social insects, has many cousins and more distant relatives which are equally interesting. The numerous bees, with their diversified habits, have an especial interest, when studied structurally and biologically, as throwing light on the origin and development not only of the higher social habits and intelligences of the true Hive Bee, but also of its structures, so remarkably fitted for their special purposes.

SPECIES OF GENUS APIS AND VARIATIONS IN APIS MELLIFICA.

The old conception of the Hive Bee, its attributes and structures, was that it exemplifies in a marvelous manner creative wisdom for man's interests. Yet, while it represents great perfection of organization and of structure, for particular ends, this perfection is relative and not absolute. Though a number of species of the genus Apis have been characterized by authors, there are but four well-defined species so far known, and three of them—*A. dorsata*, *A. indica*, and *A. florea*—are confined to India and the East Indian and Philippine Islands. The fourth, *Apis mellifica*, or the common Hive Bee, was originally introduced into this country from Europe, and doubtless had its origin in some parts of Asia. It has followed civilized man in his migrations over the globe, and has frequently anteceded him, and, being semi-domesticated, has been more or less influenced by him, as have other domesticated animals. Some ten different types of the species have been characterized by specific names, two of them, viz, *adansoni* Latr. and *unicolor* Latr., being considered good species by Frederick Smith, while a still greater number are recognized by local names among apiculturists. These varieties and races show every variation in color through the various shades of black, gray, and golden-yellow, as also every variation in disposition, industry, and tendency to swarm, and especially in honey-gathering proclivities.

Of the East Indian species only one, *Apis indica*, is cultivated. This bee, which is considerably smaller than our own, building smaller combs composed of smaller cells (36 to the square inch), chooses, when wild, a hollow tree or rocky cavity for its home. It is kept to a limited extent by the natives, earthen jars being used for hives, but the yield of honey is small.

Apis florea, the smallest of the genus, with slender, orange-banded body, builds in the more open country of India, attaching a single tiny comb to the twig of some small shrub. The worker cells are 81 to the square inch of surface, the drone cells 36.

Apis dorsata, the Giant Bee of India, attaches its mammoth combs to the limbs of tall forest trees or to overhanging ledges of rock, generally building a single comb as much as six feet long and two or three feet wide. Great quantities of wax and honey are obtained from this bee by the bee-hunters in India and the islands southeast of Asia. It has not been permanently domesticated, nor is it certain that it can be. The workers of this species are about the size of the queens of *Apis mellifica*, or from seven-eighths of an inch to an inch long. The bodies of the bees are slender and wasp-like, and beautifully marked across the abdomen with bright orange bands.

While the different species of the genus Apis thus differ in size, coloration, temperament, and habit, there are comparatively slight

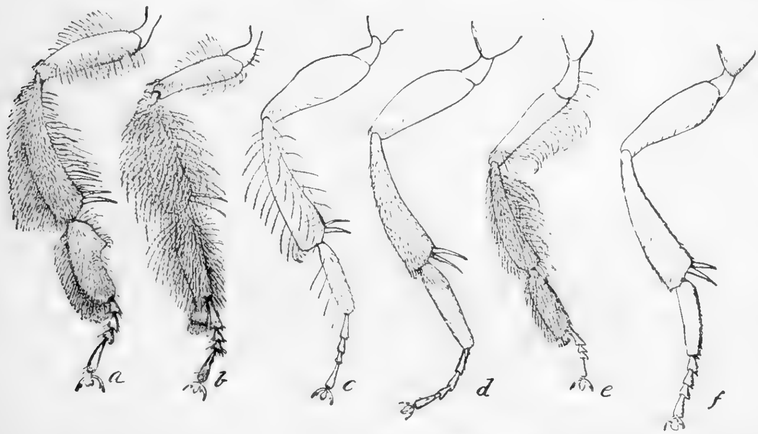

FIG. 25.—MODIFICATIONS OF THE HIND LEGS OF DIFFERENT BEES: *a*, Anthophora; *b*, Melissodes; *c*, Perdita; *d*, Nomada; *e*, Agapostemon; *f*, Nomia—all enlarged. (From Riley.)

variations in structure; a necessary inference for every zoölogist. But if we study the other species of the family Apidæ we shall find every variation, and obtain a very good idea of how the special organs in Apis may have been evolved and perfected from simpler organs in other genera. This may be illustrated by a few sketches of some of the more important structures, as, for instance, the polliniferous organs and the wax-producing apparatus. (See Figs. 23, 24, and 25.) The figures very well illustrate the fact that the modification of structure and hairy vestiture, which facilitates the collection and transportation of pollen, while exhibited perhaps in the greatest perfection in the Hive Bee, is nevertheless an evolution from similar structures possessed by other species of social bees, such as the Meliponæ and Bombi, and still more remotely from such as are possessed by the solitary bees.

In the production of wax the Hive Bee exhibits a lavishness not found in any of the wild bees, not excepting the species of Trigona and Melipona, which approach it most nearly in social economy. As a result we find that the wax-secreting organs of Apis are much larger than in any other wax-producing bees. In Bombus they are greatly reduced and otherwise different in structure, resembling, however, very closely those obtaining in Melipona and Trigona.* In the solitary bees, which produce no wax, these specialized structures are entirely wanting. These solitary bees, no matter in what situations or of what material they make their cells, generally store them with honey or pollen, and after depositing an egg, cap the cell and leave the young larva to care for itself. The habits of the social Bumble-bee (Bombus) are but a step in advance, as the larvæ are developed in a mass of pollen and honey, in which they form rather imperfect cells. When full grown each spins a silk cocoon which is thickened by a certain amount of wax, which is added by the adult bees. The females labor, and several coöperate in the same nest. In the Bottle-bees (Melipona) a still further step is seen, as the cells, of a rather dark, unctuous wax, are formed into regular combs and are somewhat imperfectly hexagonal. They are, however, in single horizonal tiers, separated and supported by intervening pillars, more like the nests of the social wasps, and the cell is sealed after the egg is laid upon the stored food, just as in the case of solitary bees. The honey is stored in separate flask-like cells, and but one queen is allowed to provide eggs.

THE SAN JOSÉ OR PERNICIOUS SCALE.†

(*Aspidiotus perniciosus* Comst.)

PREVIOUS INVESTIGATIONS.

In the Annual Report of this Department for 1880 Prof. J. H. Comstock described under the above name an insect which he had collected in Santa Clara County, Cal. He stated that from what he had seen of the species he considered it to be the most pernicious scale insect known in this country. He had never seen any other species so abundant as this was in certain orchards, and was told that it infested all the deciduous fruits grown in California except the peach, the apricot, and the black Tartarian cherry. As a remedy he suggested the use of strong alkaline washes.

* But the most interesting fact is that in the queen bee, in which they are functionless, they are nevertheless present, but more nearly resemble the same structures in Melipona.

† Republished, with some additions, from the Report of the Entomologist, Annual Report of the U. S. Department of Agriculture for 1893, and circular No. 3, new series, Division of Entomology.

Until very recently the San José Scale has been confined to the Pacific coast, but has extended north to Washington and south to the Mexican border, and has become, perhaps, the chief enemy to Pacific-coast horticulture. Considerable attention has naturally been paid to the species by California horticulturists.

In 1883 Matthew Cooke published figures of the larva, male pupa, and adult male, together with the adult female scales on twig and fruit. He stated that the insect was first noticed by fruit shippers as infesting fruit in 1873 at San José, Santa Clara County. From that time it spread rapidly until 1880, and but little effort was made to exterminate it. In the winter of 1881–'82 crude petroleum was applied extensively; in some cases with good results, but in the majority of instances with great harm to the trees, many trees dying from the effects. The remedies recommended were 1 pound of concentrated lye to a gallon of water and 6 pounds of caustic soda to 12 ounces of potash and 8 gallons of water. These remedies were to be applied only at the dormant season. For trees in leaf a wash composed of one pound of whale-oil soap, one-third of a pound of sulphur, and an ounce and a half of lye or caustic soda to a gallon of water was recommended.

In 1884 the late Dr. S. F. Chapin, in his biennial report as State inspector of fruit pests, mentioned the San José Scale, but stated that in Santa Clara County, where it first appeared, there had been a most gratifying decrease in its numbers and in the destructive effects following its presence, both results having been brought about by the intelligent and well-directed efforts of the fruit-growers. He stated that the scale had been found at that time in many different localities in the State, but had not caused any great decrease in orchard products. He urged that the pest should be watched and treated in its incipiency.

In the biennial report of the State Board of Horticulture of California for 1885–'86, the late W. G. Klee, then State inspector of fruit pests, published a short account of the insect, illustrating its characteristic appearance upon twig, leaf, and fruit. Mr. Klee stated that the insect has three distinct broods—one in June, one in August, and one in October; but that these broods overlap, and in consequence the summer washes are not thorough remedies unless frequently repeated. He therefore recommended winter treatment, consisting of the cutting back and thorough thinning of all trees above 20 feet in height, together with thorough scrubbing of the rough bark of the old trees and the application of one-half pound of concentrated lye, one-half pound of commercial potash, and 5 quarts of water.

In the Proceedings of the Eighth Fruit-growers' Convention, published in the report of the State board of horticulture for 1887–'88, Prof. C. H. Dwinelle is said to have reported the most perfect success in fighting the San José Scale in Sonoma County, Cal. A seriously infested orchard was treated with absolutely complete success by means of a wash composed of one-half pound of commercial potash, one-half pound

of caustic soda, and 5 quarts of water. This was applied when the trees were in a dormant condition.

In the report of the same board for 1889 a reprint is given of Comstock's description in an article upon scale insects and remedies. Several formulæ for summer and winter use are given, the most successful of which, and the one which has come into most general use, being the so-called lime-sulphur-salt wash for winter use. This wash consists of 40 pounds of unslaked lime, 20 pounds of sulphur, 15 pounds of stock salt, and water to make 60 gallons. The summer washes comprise potash and caustic soda, whale-oil soap and sulphur, with a slight admixture of caustic soda and potash, and a mixture of tallow and resin with a small quantity of caustic soda and potash. In the report of the board for 1891 Mr. Alexander Craw published an article entitled "Insect pests and their extermination," in which he briefly discusses this species. He considers it to be a very serious pest of deciduous trees, but states that the remedies just mentioned are so cheap and effective that no excuse can be tolerated for a seriously infested orchard. He further stated that a Chalcidid fly (*Aphelinus fuscipennis* Howard) had been found doing such effective work in subduing the species in an orchard in the neighborhood of Los Angeles that a complete restoration of the orchard was confidently expected.

In Bulletin 26 of this Division Mr. Coquillett, in his report on the scale insects of California, devotes four pages to this species. He states that its origin is uncertain, but that the fact of its being so frequently found upon plants imported from Japan would seem to point to that country as its original home. He states that the species never attacks citrus or coniferous trees, and that the LeConte Pear, when growing in the midst of other varieties of Pear, is almost exempt. The Twice-stabbed Ladybird (*Chilocorus bivulnerus*) is mentioned as being the most abundant and efficacious enemy of the scale, although Mr. Coquillett has never known an instance where even one single tree has been entirely or very nearly freed from the scale by the work of this beetle. The article concludes with a series of experiments with washes. The result of these experiments was that the resin and caustic soda wash recommended by Mr. Coquillett in Bulletin 23 of the division was found to be superior to the others. This wash is to be applied only during the dormant season, and consists of 30 pounds of resin, 9 pounds of 70 per cent caustic soda, 4½ pints of fish oil, and water to make 100 gallons.

Mr. Coquillett's testimony as to the good offices of *Chilocorus bivulnerus* coincides with that of other observers, but a surprising instance, which indicates that the species may occasionally prove extremely effective, was mentioned in the *California Fruit Grower* in 1892. It was there stated that Mr. N. W. Motheral procured a number of these beetles in San Diego County [date not given] and placed them in some orchards in Tulare County which were badly infested with the scale. They did not appear to multiply greatly until the spring of 1892,

"when immense numbers appeared simultaneously and completely cleared the orchards of the county of the scale."

An interesting ladybird of the genus Scymnus was found in 1892 by Dr. Blaisdell preying upon the San José Scale at the Coronado parks, near San Diego. This species was described by Dr. Blaisdell as *Scymnus lophanthæ* n. sp., but has not proved very effective in destroying the Aspidiotus.

In the September, 1892, number of the *Agricultural Gazette* of New South Wales Mr. A. Sidney Olliff reported the receipt of a typical series of *Aspidiotus perniciosus* on the fruit, leaves, and twigs of Pear from West Maitland, New South Wales. Mr. Olliff further stated that although this species had not previously been recorded as occurring in Australia, it had been known to some fruit-growers for a number of years.

In an important paper read by Mr. Alexander Craw before the State Horticultural Society of California, December, 1892, the San José Scale is stated to be unquestionably of foreign origin, and it is further surmised, on the authority of Mr. John Britton, of San José, that it was introduced into California upon trees received from Chile by the late James Lick.

In Bulletin 7 of the New Mexico College of Agriculture, published in June, 1892, Mr. C. H. Tyler Townsend, entomologist of the station, records the occurrence of the species at Las Cruces upon apple, pear, plum, peach, quince, and rose, and states that it was brought into New Mexico on young trees from California. The winter eggs are mentioned in Mr. Townsend's account as turning orange-yellow in spring and hatching the first or second week in May.

SUDDEN APPEARANCE OF THE SPECIES IN THE EAST.

The first week in August, 1893, Dr. C. H. Hedges, of Charlottesville, Va., sent specimens of pears and peaches affected by this insect to the Division of Vegetable Pathology of this Department, on the supposition that the scales were the manifestation of a fungous disease. They were referred to this Division and Dr. Hedges was informed of the destructive character of the insect, and advised to spray with kerosene emulsion, as examination of the specimens showed that the insects were hatching at the time. He was unable to trace the origin of the trouble. He sent specimens from pear, currant, plum, Japanese plum, and dwarf apple.

In view of the great importance of the subject, Mr. E. A. Schwarz was sent to Charlottesville about the middle of August to make a thorough investigation, and in December Mr. D. W. Coquillett was sent to continue them, and to definitely delineate the area of infection. From the detailed reports submitted it appears that the scale occurs most abundantly in a little pear orchard forming a square of about one-third of an acre about one-third of a mile from the center of the city, adjoining one of the main roads leading into the open country. The orchard

is practically isolated, being bounded upon one side by a vineyard, on another by the garden of a neighbor, on a third side by the road, and on the fourth by a lawn. It is planted with choice dwarf fruit trees, mainly pears. They are crowded together, and in many cases the branches interlock. The orchard was set out about eight years ago, and is now very badly infested. The quince and Japan persimmon carry no scales; a few occur upon dwarf apples and a few upon peaches. The Lawrence pears are also but slightly affected. The Duchesse d'Angoulême and its varieties, and the Bartlett and its varieties are very badly attacked, particularly the former. Raspberry bushes are not affected, but currant bushes are covered. A few specimens also occurred upon rose bushes. Two hundred feet away from the infested orchard, and in the middle of the vineyard, other apple, peach, and pear trees occur, but all were absolutely free from scales. Two old apple orchards at a very considerable distance were also absolutely free. In point of fact, the insect had not spread to the north, east, or west. Towards the south, however, it had spread to some extent into the garden of a neighbor. This is a flower garden, but contains a few scattered fruit trees. In this garden the scales were found in moderate numbers on a peach tree, on some pear trees, and on two rose bushes. Still further south is another garden belonging to a neighbor, and in this garden a few specimens of the scale were found upon a single pear tree.

The insect is therefore definitely limited and confined to a small space, and there seems to be no doubt that the species made its first appearance in Dr. Hedges' pear orchard. It is also undoubtedly a recent importation, since the orchard was planted only eight years ago, and since the species has spread so slightly.

Mr. Schwarz was able to gain no definite information concerning the mode of importation. Dr. Hedges has never bought any nursery stock or other plants from California. His oldest trees were purchased eight years ago in New York. Certain others were purchased in Augusta, Ga., three years ago, and two years ago another lot was obtained from Crozet, Albemarle County, Va. The time of purchase of the last lot coincides with the time when the scale was first noticed, but Dr. Hedges is positive that these trees were not infested when purchased, and states that the scales were first noticed at another point in the orchard among the oldest pear trees, near certain old currant bushes which died and were removed before the scales were noticed upon the trees. Mr. Schwarz then inquired as to the history of these currant bushes, and ascertained that they were purchased eight years ago from a New Jersey nursery. Dr. Hedges thinks that they died from a scale insect attack, but since this was long before the scales were noticed in the pear trees, the statement is doubtful. Moreover, had the insect been originally introduced upon currant bushes eight years ago, the whole orchard would probably have been infested long since, and the insect would have spread to a much greater distance.

The question as to the mode of importation is, then, surrounded with considerable difficulty, and it would seem, at the first glance, more plausible that the insect had become accidentally established from California fruit than from nursery stock. This was the conclusion to which Mr. Schwarz came after his investigation. He found that California pears are sold in the fruit stores of Charlottesville, and also upon the trains of the Richmond and Danville Railroad passing through the city. He therefore suggests the plausible idea that some person passing along the highway had tossed the rejected portions of a pear over the fence, and that from this small beginning the difficulty originated. In support of this view it may be stated that the insects gather by preference in the pit around the calyx end of the fruit, where they are not likely to be noticed and from which point they can not be rubbed in polishing the fruit with a cloth. Against it, however, is the further fact that not a single specimen of this insect on California pears has ever been noticed in the Washington markets. Its appearance is so characteristic that it could hardly fail to attract the attention of an entomologist, and yet none of our assistants have ever seen one, although California pears are extremely abundant on the fruit stands of Washington, as in most of our eastern cities. Moreover, the greatest care is exercised in California to offer only perfectly clean fruit for sale, and there are State laws prohibiting the sale of infested fruit. Two years and a half ago a case was reported in the *California Fruit Grower*, where a Riverside fruit dealer was fined $10 for selling fruit infested with this scale insect, and since that time the law has been more or less rigidly enforced. Moreover, if infested fruit were commonly brought to eastern markets, cases similar to this would have been of frequent occurrence. Indeed, it is difficult to suppose that in this event the species would not have long since obtained a foothold all through the East, since it would easily establish itself upon almost any deciduous plant near which living specimens might find themselves.

This argument, written in December, 1893, has been borne out by subsequent developments. The San José Scale has since been found in great numbers in extensive orchards near De Funiak Springs, Walton County, Fla., at Riverside, Charles County, Md., at Neavitt, Talbot County, Md., in several localities in New Jersey and eastern Pennsylvania, and upon a few trees only at Bartle, Washington County, Ind. In all of these cases the introduction of the scale has been traced directly to nursery stock received from New Jersey or Missouri.

APPEARANCE OF INFESTED TREES.

During summer it is noticeable that the scale has a tendency to infest only the extremities of the trees or the new growth, especially of the lower branches, and the fruit. The leaves are attacked (and Mr.

Schwarz found this particularly true of the Duchess and Bartlett pears) along the midrib on the upper side of the leaf in one, two, or more quite regular rows, also to some extent along the side ribs, the male scales predominating over the female in such situations. The infested leaves turn purplish-brown, but do not have a tendency to fall. When occurring upon the fruit the scales have a distinctive peculiarity, in that they are invariably surrounded by a purplish discoloration of the skin of the fruit, and this discoloration is also noticed to some extent on the young growing twigs. The cambium layer of wood beneath the scales is stained purplish to some extent. In winter the scales upon

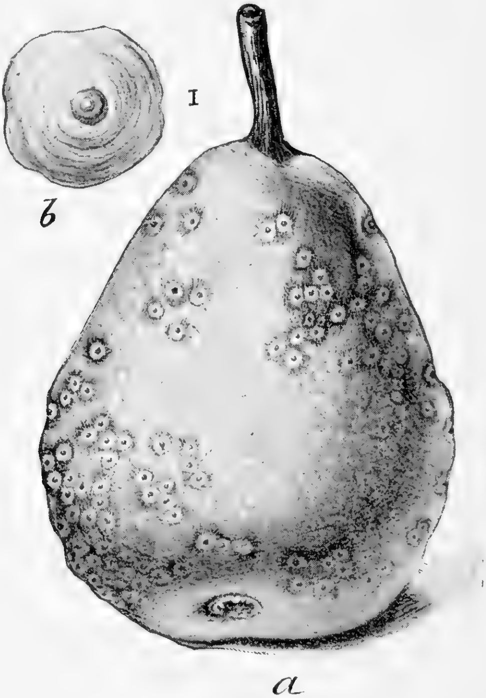

FIG. 26.—San José Scale: *a*, pear, moderately infested—natural size; *b*, female scale—enlarged. (From Circular No. 3, Div. Ent.)

twigs are difficult to distinguish. They lie close to each other, frequently overlapping, and can only be differentiated with a magnifying glass. The general appearance which they present is of a grayish, very slightly roughened, scurfy deposit. The natural rich reddish color of the limbs of peach and apple is quite obscured when these trees are thickly infested, and they have then every appearance of being coated with lime or ashes. When the scales are crushed by scraping a yellowish, oily liquid will appear, resulting from the crushing of the soft, yellow insects beneath the scales. An infested pear is shown at Fig. 26 *a*, and an enlarged female scale at *b*. The appearance of an apple twig

infested by the scales during winter is shown at Fig. 27, while the slightly enlarged scales are shown above at the left in the same figure.

NATURAL ENEMIES AT CHARLOTTESVILLE.

No parasites, and no scales from which parasites had issued, were observed at Charlottesville. The common little Malachiid beetle (*Collops quadrimaculatus*) was observed feeding in small numbers upon the newly-hatched larvæ. The Coccinellid beetle (*Pentilia misella*) and its larvæ were very abundant on the infested trees, and this species Mr. Schwarz thinks a very important enemy of the scale. The beetles seem to prefer the full-grown female scales, while the larvæ feed upon Aspidiotus larvæ. The larvæ customarily transform to pupa within the calyx of the pears. This little cavity was always found literally filled with a mass of young and old scales, full-grown Pentilia larvæ and pupæ, and recent imagos. The fact that this beetle, which is essentially an eastern species, so readily and effectively began to feed upon this introduced scale is a very interesting one entomologically, and would justify an effort to introduce and colonize it in southern California.

FIG. 27.—San José Scale: Apple branch, with scales in situ—natural size; enlarged scels above, at left. (From Circular No. 3, Div. Ent.)

HOW THE SPECIES IS DISTRIBUTED LOCALLY.

Some interesting observations were made by Mr. Schwarz upon the transporting of the young Coccid larvæ by other insects. This very Pentilia was unconsciously an active agent in this dangerous work. Hardly one of the beetles could be found which did not carry on its back at least one Aspidiotus larva, and sometimes three or four were found upon a single wing-cover of a beetle. A small black ant (*Monomorium minutum*) was abundant upon the pears, attracted by the juice emerging from the cracks, and almost every one of these ants carried on its back one or more specimens of the Coccid larvæ. Specimens of a little Chrysomelid beetle (*Typophorus canellus*) were also found upon the trees. Red and black specimens of these beetles occurred, and the interesting observation was made that while the Aspidiotus larvæ crawled freely upon the black individuals, no specimens were to be

found upon the red ones. This same peculiar fact was also found to hold with the ants, since the red ant (*Formica schaufussi*) was abundant upon the pears, but no specimens were found bearing Aspidiotus larvæ, while, as just stated, the little black Monomorium was always found carrying specimens. Curiously enough, no ladybirds other than Pentilia were seen. The common Twice-stabbed Ladybird (*Chilocorus bivulnerus*), which is so sctive an enemy of scale insects and plant-lice throughout the Southern States, was absent.

STAMPING OUT THE SPECIES AT CHARLOTTESVILLE.

Believing, from Mr. Schwarz's report, that the area in which the insect occurs around Charlottesville was yet limited, and feeling the importance of effectual steps being taken to stamp it out, because of the danger of its future spread to the rest of the State of Virginia and to the whole Atlantic fruit region, the Entomologist was anxious to still more definitely delimit its range, and Mr. D. W. Coquillett, who has had much experience with the insect in California, was directed to make a second survey of the field. He spent some time at Charlottesville in December, and his report fully confirmed the observations of Mr. Schwarz, and showed that the species was limited to the region already indicated. On account of the small number of trees concerned, it was deemed best to make an effort to stamp the scale out by means of the gas treatment. Mr. Coquillett was accordingly sent to Charlottesville in March, with the necessary apparatus, and, with the coöperation of Dr. Hedges and Mr. H. L. Lyman, of the Virginia State Board of Agriculture, every infested tree was thoroughly treated, with the result that we are able to announce the practical extermination of the scale at this point. It has since been found upon two or three small, untreated plants, and these have been destroyed by Dr. Hedges by burning.

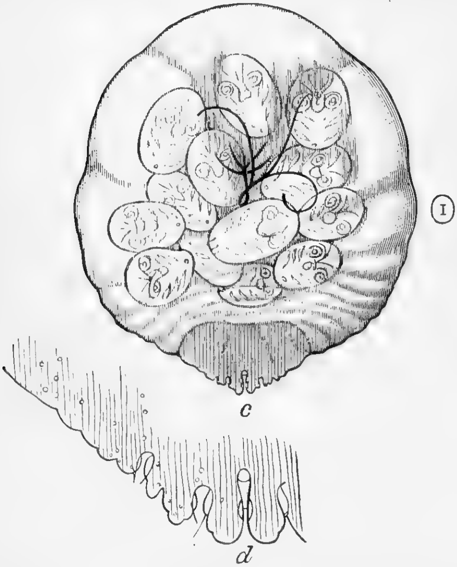

FIG. 28.—San José Scale: *c*, adult female containing young—greatly enlarged; *d*, anal fringe of same—still more enlarged. (From Circular No. 3, Div. Ent.)

DESTRUCTION OF THE SCALE AT OTHER POINTS.

In the large orchard at Riverside, Md., extensive spraying operations have been conducted, and the scale is now under control. Both the kerosene emulsion and the resin wash have been used in these operations. The kerosene emulsion is effective against the young

scales, and the resin wash, in the absence of immediately following rains, against the full-grown insects. Similar operations have been begun at Neavitt, Md. In Indiana the scale was confined to a very few trees, and these were destroyed by cutting down and burning. In the only locality in Pennsylvania with which we have had direct correspondence, the scales were also destroyed by burning the trees. In New Jersey, as we learn from Prof. John B. Smith, kerosene emulsion has been used successfully, both prior to the hatching of the young and subsequent thereto.

STRUCTURAL CHARACTERS OF THE INSECT.

A careful study of the life-history of the insect is being carried on in the Insectary of the Division. For the purposes of this article it will

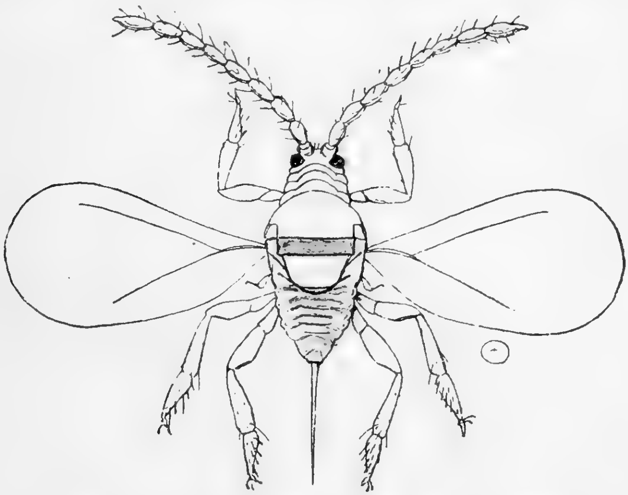

FIG. 29.—San José Scale: male adult—greatly enlarged. (From Circular No. 3, Div. Ent.)

be sufficient to republish the figures of the adult male and of the adult female, removed from the scale. These are shown, respectively, at Figs. 29, 28, and 26 *a*.

COMPLETED LIFE-HISTORY OF THE SUGAR-BEET WEB-WORM.

(*Loxostege sticticalis* L.)

By L. O. HOWARD.

In the Annual Report of this Department for 1892 Prof. Riley gave, on pages 172 to 175, some account of the occurrence of this insect in injurious numbers in sugar-beet plantations in Nebraska, his attention having been called to it by the agents of the Division of Chemistry

stationed at the Experiment Station at Schuyler, Colfax County, Nebr. The same year the matter was investigated by Mr. Lawrence Bruner, who reported briefly upon the species upon pages 37 to 40 of Bulletin No. 30 of this Division. In INSECT LIFE (vol. v, pp. 320–322) was published an editorial article giving the results of brief observations made during the fall of 1892 and early spring of 1893.

During the summer of 1893 damage to sugar-beets was not noticed, and the outbreak of 1892, which attracted so much attention, must be considered as unusual and, perhaps, owing to unusual conditions. Mr. Bruner shows that the insects were more plentiful in the middle of large fields than in small ones and in those which were allowed to run to pigweed (Chenopodium) the preceding year than those in which these weeds were kept down. It was also more abundant in places where the soil was sandy than elsewhere. It is believed, therefore, that Chenopodium is the normal food-plant of the species.

In these several accounts certain details in the life history of the insect are omitted and these I may briefly mention in this article.

The larvæ were first observed in 1892, in the latter part of July, when they appeared in enormous numbers in the beet-fields at Schuyler. An August generation followed, and although in the Annual Report for 1892 it was surmised that there were three and possibly four generations, the fact was not definitely known. The moths issued in the Insectary at Washington the last week in May and the first week in June, from cocoons sent in the latter part of September from Nebraska, and also early in May from the same location, making it reasonably certain that there is a June generation of caterpillars and that the insect is in Nebraska normally three-brooded.

The method of hibernation is in the larval state within a long, subcylindrical silken case closely plastered with earth, such as is figured in INSECT LIFE (vol V, p. 231, Figs. 43*d* and 45*a* and *b*). In the Insectary the larvæ transformed to pupæ during May. A lot of cases received in May, 1892, from Nebraska contained 72 in the larval condition and 53 in the pupal condition. One of the larvæ had just changed to pupa. The first moth issued May 10 and the last one June 9.

During the same year (1892) the same insect was received from Mendon, Mich., where it was reported as damaging Tansy grown by one of the members of the so-called "Park Central Mint Growers' Coöperative Association." The patch in which the larvæ were found contained five or six acres in rows three feet apart. The larva first made its appearance in August and caused very considerable damage by eating the leaves. A later brood appeared the latter part of September and caused the loss of about 50 per cent on the yield of oil from the patch. The larvæ were cared for in the Insectary and the first moth issued May 11, 1893. Other food-plants of the species will doubtless be found.

Mr. Bruner, in Bulletin 30, stated that the insect was subject to the attacks of a number of parasitic insects, while it also was preyed upon by several predaceous insects. The most abundant parasite he found to be a "small yellowish hymenopterous fly." He also mentions a "flesh-fly" and states that "several other parasites have thus far been bred from the web-worms contained in breeding cages." This state-

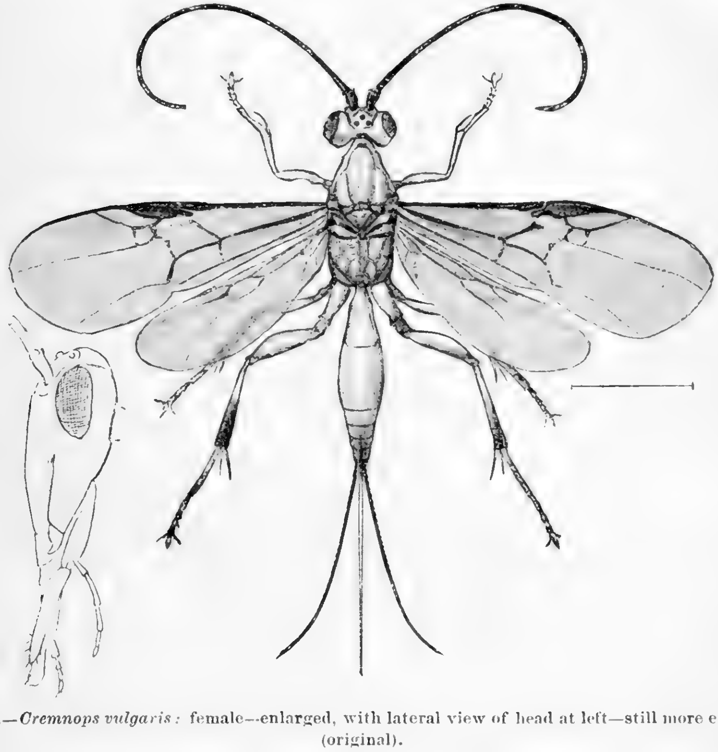

FIG. 30.—*Cremnops vulgaris*: female—enlarged, with lateral view of head at left—still more enlarged (original).

ment is corroborated by our experience at Washington. The "small yellowish hymenopterous fly" which is mentioned by Mr. Bruner is probably one of two species of the genus Meteorus reared here. The most abundant of these is *M. œcopsidis* Ashm., which was reared in May and early June from cocoons received from Mr. Walter Maxwell, of Schuyler, Nebr., during the same month. This species was previously reared by Miss Murtfeldt from an undetermined Tortricid larva of the genus Eccopsis. The other Meteorus was *M. indagator* Riley, one specimen of which was reared May 11 from a cocoon received the previous fall from Mr. H. A. Edson. This species was previously reared by Prof. Riley from one of the little cabbage-worms—*Evergestis rimosalis* Gn., from Oxford, Miss. Most abundant of all of the parasites, however, was *Cremnops* (*Agathis*) *vulgaris* (Fig. 30), 17 specimens of which were

reared the last week in May and the first week in June from the cocoons received from Mr. Maxwell. Two specimens of *Chelonus electus* Cr. (Fig. 31) were reared on the 6th and 8th of June from the same lot of cocoons and a single specimen of *Limneria melanocoxa* Ashm. was reared on the 22d of May. The smooth, shining, semitransparent cocoons of the Cremnops are found occupying the rear portion of the long cocoon tube of the web-worm. Their location is indicated at Fig. 45*b*, p. 321, vol. V, INSECT LIFE. Of the smaller, tougher, dark-brown cocoons of the Meteorus three or four may be found in a single case of the web-worm. We are unable to identify the cocoons from which the Chelonus and Limneria issued.

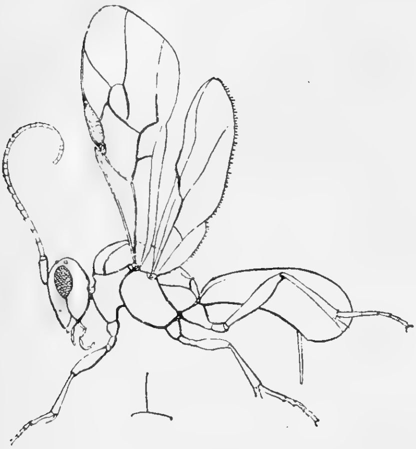

FIG. 31.—*Chelonus electus*: female—greatly enlarged (original).

In addition to these hymenopterous parasites two Diptera have been reared. They have been named by Mr. Coquillett. The first is a single specimen of *Sarcophaga helicis* Towns. (See *Psyche*, Feb., 1892, p. 220), the type of which was reared by Mr. H. A. Surface from a living snail. The case of the Sugar-beet Web-worm, from which this fly emerged, was fortunately found. The anterior portion was occupied by the puparium of the fly and the posterior portion by the dry and shriveled skin of the web-worm larva. This was one of the cocoons sent to us by Mr. Maxwell in May, 1893. The Sarcophaga emerged on the 5th of June following. The second Dipteron is *Phorbia fuscipes* Zett. This is the species which was found abundantly during the outbreak of the Rocky Mountain Locust to feed upon the eggs of the locust, and was described by Prof. Riley as *Anthomyia radicum* var. *calopteni*. Mr. Coquillett also informs me, after an examination of Fitch's type of *Hylemyia deceptiva* now in the collection of the U. S. National Museum, that this insect, called by Fitch "the Deceptive Wheat-fly," is also identical with this species. The species has also been reared by Prof. Riley from cabbage and radish roots. The parasitism of the species on the web-worm larva is very doubtful, and it is more likely that the Phorbia larva, from which this fly was reared, fed upon the beet root and perhaps crawled into the larval case of the web-worm for pupation. In view, however, of the well-known locust-egg-feeding habits of this species the fact is well worth mentioning here. Of the hymenopterous parasites above mentioned the Cremnops, the Limneria, and the Chelonus have, so far as I know, never before been reared.

REMEDIES.

From our study of this insect, we may conclude that the damage done by it in 1892 in beet fields was very unusual and hardly likely to recur except under peculiar conditions. The insect is not likely to reproduce in numbers for two consecutive years upon a crop which must be as thoroughly cultivated as the sugar-beet, and such an outbreak will seldom occur except where waste land, on which the normal food-plant of the species grows in quantity, is broken up and seeded to some cultivated crop, like the beet, which is closely allied to the natural food-plant. The plain inference points to the avoidance of such a course.

When the insect itself appears on a plantation of sugar-beets, the crop should at once be sprayed with an arsenical mixture. A few days' delay may work very considerable damage, as the larva feeds ravenously and develops with great rapidity. According to an interesting manuscript report by Mr. H. B. Edson, small holes were observed in the leaves at first without the larvæ being discovered and in thirty-six hours from that time half of the foliage of a plat was destroyed. Paris green should be applied at the rate of one pound to 100 gallons of water. The hibernating larval cases are found near the surface of the soil and a thorough harrowing will bring the majority of them quite to the surface, where they will be exposed to frosts and to the attacks of insectivorous birds and animals. Mr. Maxwell found after an experiment of this kind that the following spring the exposed cocoons had been largely emptied by birds such as the Meadow Lark and Quail, while the great majority of the remainder were dead.

NOTES FROM CORRESPONDENCE.

Abundance of the Peach-twig Borer in Washington.—The well-known Peach-twig Borer of the East (*Anarsia lineatella*) has been doing considerable damage in the State of Washington, as we learn from Mr. Chatfield Knight, member of the State Board of Horticulture, who lives at Vancouver. Mr. Knight has noticed as many as 100 of the larvæ of this insect upon a single three-year-old prune tree.

Potato-tuber Moth.—Mr. Max Albright reports the recurrence of the Potato-tuber Moth (*Lita solanella*) in California, in the country between Los Angeles and Santa Monica.

Grasshopper Damage in Minnesota.—Mr. H. B. Ayres reports that *Camnula atrox* is very abundant at Carlton, Minn. He wrote, under date of July 7, that for two weeks they had been marching west and were then flying, rising like bees and making flights farther than one can see, but nearly always westward.

A new Chrysomelid on Apple in California.—We have received, through Mr. Gustav Eisen, of San Francisco, Cal., specimens of a Chrysomelid beetle, *Colaspidea smaragdula* Lec., with the information that it appeared during May in apple orchards. Mr. Coquillett, of this office, states that he has observed this beetle feeding upon leaves of grape and other plants, including *Artemisia californica*. It is evidently a general feeder like the allied *Typophorus canellus* and *Graphops nebulosus*, the so-called strawberry root-borers, and feeds in the larval condition on the roots of one or more of these plants.

The Army Worm the Present Summer.—Owing largely to the drought of last season and the wet spring of the present year, the Army Worm has appeared in injurious numbers in several localities in the eastern States. We have had reports from Richmond, Va., May 29; Chester, Va., June 5; East Hampton, L. I., N. Y., July 9; Augusta, Wis., July 10; Wausau, Wis., July 19; Nadeau, Mich., July 18; and Conner, Pa., July 21.

GENERAL NOTES.

COÖPERATIVE WORK AGAINST INSECTS.

The *American Cultivator* for May 26, 1894, tells an interesting story about a recent move undertaken by the Genesee Valley Forestry Association. It seems that the Association a year ago offered prizes to the school children who should gather the largest number of cocoons of an insect which is somewhat indefinitely described as "the caterpillar which infests fruit and forest trees"—probably Clisiocampa. The three children gathering the largest number were to receive $5 each; the next three, $3; and the next three, $2 each. The highest prize was won by a boy who gathered 44,000 cocoons. Last winter the Association extended its offer, with the most amazing results. Clubs were formed, and it is doubtful whether any tree in the neighborhood remained unvisited and unexamined. One boy gathered 951,871 cocoons; another, 437,258; a third, 123,666; and a fourth, 88,238. Could more good have been accomplished in any other way by the same expenditure of money?

LEGAL ASPECTS OF FUMIGATION IN CALIFORNIA.

The Santa Ana (Cal.) *Weekly Blade* for June 9, 1894, reports that the Horticultural Commissioners of Orange County have filed liens upon the real estate of five fruit-growers in that county to cover the expense of fumigating their orchards, as required by law. The liens range from $117.05 to $285.30 in amount, but the item does not state what provision is made for collecting the money.

NOTES FROM ILLINOIS.

Chinch bugs are much more abundant here than usual. They are to be found in such numbers in grass and grain fields that a very serious chinch-bug outbreak is apparent.

Cutworms were not as common as usual during the early spring, but are now to be found in fair abundance. The Army Worm (*Leucania unipuncta*) has commenced to deposit eggs.

Aphis mali does not occur in usual numbers. During the warm weather before the middle of March, most of the eggs of this species hatched, and the cold weather in the last of March killed thousands of young Aphides; in fact, it was impossible to find any living specimens, although dead ones in great numbers clung to the apple twigs. Later

the remainder of the eggs hatched, and at this time (May 12) the winged pseudogynes are giving birth to young on the apple leaves, and also on the roots of some grasses, e. g., Timothy (*Phleum pratense*).

Empoasca mali is present in considerable numbers on apple trees and other plants. Adults were first observed in the orchard of the University of Illinois, May 7. Now larvæ, nymphæ, and adults are very common.

Teras minuta is at present the most destructive insect affecting young apple trees here. The larvæ are almost, or in many cases quite, full grown. Nurserymen are both spraying and picking by hand.

The moth of the Apple-leaf Skeletonizer (*Pempelia hammondi*) has just emerged (May 12) in my breeding cages. This rivals the foregoing species in the amount of damage to apple trees in this State.

The Apple Ornix (*Ornix geminatella*) is sufficiently abundant to make its presence quite objectionable in orchards. The adult moth was first captured March 31.

Eggs of a mealy bug (Dactylopius) have been found during the past winter and spring in great abundance in the culms of Timothy and straws of the small grains. The young mealy bugs commenced to hatch May 4. [H. A. SURFACE, *Champaign, Ill.*]

ANOTHER TRIAL WITH ENGLISH HESSIAN-FLY PARASITES.

During the month of May Mr. Fred. Enock, of London, England, sent to this office a box of puparia of the Hessian Fly infested by *Entedon epigonus* (*Semiotellus nigripes* Lind.). The parasites were already issuing from the puparia, and they were therefore sent to the most convenient of the suitable places, namely, Fredericktown, Md., and were liberated in a wheat field on the farm of Mr. G. Morgan Eldredge, of Philadelphia.

PROVANCHER'S ICHNEUMONIDÆ.

Prof. G. C. Davis, of the Michigan Agricultural College, has just published in the Proceedings of the Academy of Natural Sciences of Philadelphia, pages 184–190 of the volume for 1894, a paper entitled "Some Notes from a Study of the Provancher Collection of Ichneumonidæ." The species which Mr. Davis found in the collection (which as a whole is located in three rooms of the Parliament Building at Quebec, having been purchased by the Province) were carefully studied by him, and his comments are published in the shape of a synonymical list. Many of the types were not seen, but there is sufficient information in the paper to well justify its publication. Provancher worked so entirely alone that many of his numerous species will be found to be synonyms, and it is very gratifying to know that the collection has been placed in so accessible a location as Quebec, and in the hands of so careful a curator as Mr. Saussure. The collection was offered to the National Museum at Washington, but funds were lacking for its purchase.

CUTWORMS AND THEIR HYMENOPTEROUS ENEMIES.

We have lately received from Mr. I. W. La Munyon, of the Colorado Weather Service, specimens of a digger-wasp, *Ammophila luctuosa* Sm., and an Ichneumonid, *Cryptus robustus* Cr., with interesting notes on their habits. The digger-wasp, like other species of the genus Ammophila, provisions its nest with caterpillars. The species in question, according to Mr. La Munyon, preys upon certain cutworms, which he states are very destructive to crops in his vicinity. The wasp was observed to dig up the cutworms, sting them, dig a new hole in the earth, and then bury them after depositing eggs upon them. An individual was noticed July 8 selecting a place to dig for a cutworm. It rested prostrate on the ground with antennæ outstretched, also touching the ground, occasionally circling about in a space of about 6 inches diameter, and after selecting the proper spot soon unearthed the cutworm.

The Ichneumonid also digs after the cutworms and deposits eggs upon them. This species will dig down about 2 inches, remain for some time at the bottom of the hole, apparently listening, when suddenly it again begins to dig, perhaps in a new direction, and soon finds its victim.

The sting of the wasp paralyzes the cutworm, and the wasp thereafter fills up the hole, hiding it carefully from view by restoring the earth to its natural condition, sometimes carrying stones and depositing them on the spot where the hole was, as observed by Mr. Th. Pergande and recorded in the Proceedings of the Entomological Society of Washington (vol. II, p. 256). The sting of the Cryptus, however, does not paralyze the cutworm, but the eggs which are inserted hatch into larvæ, which do not interfere for a time with the feeding habits of the cutworm. The Cryptus makes no attempt to fill up its hole.

BRAN AND PARIS GREEN FOR CUTWORMS.

Mr. R. C. Allen, of Bonita, San Diego County, Cal., publishes in the *California Fruit Grower*, under date of May 26, an interesting account of his success in the use of bran and Paris green against cutworms, which infested his vineyard. He mixed three pounds of Paris green to a sack of rye bran, stirred it thoroughly, moistened it, and then threw a handful or so of the mixture about the trunk of each vine. He says that there were many cutworms in his vineyard, and that last year his vines were leafless from their work. This year ten pounds of Paris green and a few sacks of bran completely destroyed the worms in a vineyard of thirty acres before any damage was done.

THE EMERGENCE OF PRONUBA FROM YUCCA CAPSULES.

Mr. J. C. Whitten has just sent us a paper under this caption, reprinted from the Fifth Annual Report of the Missouri Botanical Gardens, in which he announces that during August, of 1893, he was

able to follow the larvæ of *Pronuba yuccasella* in their journey from the capsules of *Yucca filamentosa* to the ground. The observation is noteworthy for the reason that this point has been up to the present time the only break in the life-history of Pronuba. Mr. Whitten found that, as had been anticipated by Prof. Riley, the larvæ leave the capsules during rainy weather, when the ground is softened and consequently easily penetrable. They do this, however, either during the daytime or at night, and not exclusively during the end of the night, as had been predicted by Riley. The larva issues from the capsule and drops quickly down at the end of a silken thread.

NOTES ON THE EUROPEAN LEOPARD MOTH.

Mr. Henry Herpers, a member of the Entomological Society of Newark, N. J., sends samples of the work of *Zeuzera pyrina* cut from a branch of *Acer dasycarpum* which was blown from the tree by an April storm. In an accompanying letter he directs attention to a number of interesting facts in the economy of the species. In all the twigs sent the larva had been working upward instead of the reverse, as mentioned by Machesney (*Ent. Am.*, vol. VI, p. 36). One of these, measuring but three-eighths of an inch in diameter, and within which it would seem impossible for the larva to complete its growth, appears to indicate that the larva after attaining a certain size must forsake its original habitation for a larger branch or perish.

He mentions also some facts that have already been noted by others, viz, the excessive superabundance of males and the attractiveness of electric light for the species. This insect, it will be remembered, was not known with certainty to have established itself in this country until 1887. During the following year Mr. Herpers thinks that of several hundred taken about Newark not a half dozen were females. In 1892, however, he noticed in one evening several scores of the females that had been crushed under the electric lights by passing pedestrians, the large pink egg-masses furnishing proof of the sex.

A LEAF-CHAFER ATTACKING PETUNIAS.

Mr. J. S. Strayer, of Port Republic, Va., an old correspondent of the Division, sends specimens of the Scarabæid, *Anomala undulata* Mels. (*varians* Fab.), with the information that they damage a number of cultivated flowers, particularly petunias. He writes, under date of June 23, 1894, that they eat into the flower to the heart, burying themselves nearly out of sight. They work rapidly, and it requires only a short time to riddle and destroy a flower. On some blossoms as many as twenty beetles were found. They appeared to show a marked preference for white flowers.

This species is known to be somewhat omnivorous in the adult state, and an account of damage to wheat is given in the report of the Ento-

mologist for the year 1884 (p. 412). The wheat crop of one farmer in Marion County, Kans., was reported that year to have been damaged to the extent of a thousand bushels.

A SEVERE CONORHINUS BITE.

Mr. J. B. Lembert, of California, with whom we have had considerable correspondence, particularly on the subject of the bite of the Cone-nose, writes us, under date of May 7, that upon the 5th of May a Conorhinus stung him at 2 o'clock in the morning, while in bed, upon the middle toe of the left foot. Mr. Lembert used saliva to ease the itching sensation, but this continued and finally spread over the toes, up the instep, legs, thighs, and loins, where large, flat blotches were raised. It finally extended further up the hands and arms; his lips swelled; his neck, nose, and eyebrows itched and swelled on scratching, and his scalp was a mass of lumps from the same cause. He stood this as long as he could and then went out to a water ditch and soaped and bathed his body in cold, melted snow-water, and applied bacon grease thoroughly. A little later he became sick at his stomach and took a strong cup of coffee. About six o'clock in the morning the itching abated, but the swelling remained on his hand and foot until the next day. In a later letter Mr. Lembert states that he has noticed that the Conorhinus is attracted by carrion, and he explains a large number of the poisonous effects of the bite by the mechanical conveyance of putrid animal matter to the wound made by the beak of the insect.

A NEW REMEDY FOR CHERMES.

A correspondent from Philadelphia writes us that having a fine tree of hemlock-spruce badly affected by *Chermes pinicorticis*, he was advised to dig a trench around the tree and put in chlorate of potassium as a remedy for the insect. He followed the advice, and also used nitrate of soda in the same way. The result was that while the tree grew a little greener in the winter time, the summer saw it gradually dying. This remedy is new to us. It seems to be on a par with boring auger holes into the trunk and filling them with sulphur!

CICADA EGGS.

We have had several reports from the South and elsewhere that the old supposition as to eggs of the "Seventeen-year Locust" being poisonous is again revived. A correspondent in Mississippi writes that the woods are full of blackberries, but the negroes absolutely refuse to gather them because, as they express it, "Them singin' locusses done pizened 'em with their aigs." A newspaper item states that a little girl living near Jackson, Miss., was poisoned by eating blackberries on which the seventeen-year locust had deposited its eggs. It naively adds, however, that "she will live."

KEROSENE EMULSION AS A DETERRENT AGAINST GRASSHOPPERS.

Grasshoppers were very abundant in central Texas during 1893. An interesting experiment was tried in an orchard by the staff of the State Experiment Station. A thorough spraying of the orchard trees resulted in the apparent destruction of none of the grasshoppers, but they soon ceased eating, left the orchard, and did not return to it for days.

OBITUARY.

We have learned since the publication of the last number of INSECT LIFE of the death of two well-known writers on North American insects, both of whom will be greatly missed by entomologists. One, Mrs. Julia P. Ballard, wrote mainly on the popular side of entomology, and her recent book "Among the Moths and Butterflies" combined the most charming style of diction with the strictness of science as to its facts. Many of our readers may be interested to learn, as we were, that Prof. Harlan H. Ballard, the founder of the Agassiz Society, is her son. Her surviving husband, Addison Ballard, is professor in the University of the City of New York.

The other death, which we greatly regret to have to record, is that of Mr. Edward Norton, a well-known writer on the Hymenoptera. Mr. Norton's papers were devoted mainly to the Tenthredinidæ, although he catalogued the species Ophion, Anomalon, and Campoplex, and also published two careful papers upon ants. In addition to this his monograph of the Chrysididæ of North America formed a basis for our study of this group in this country. Mr. Norton had not published any important papers on entomology for the past fifteen years.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

February 28, 1894.—This meeting was devoted to an address by Prof. E. B. Poulton, of Oxford University, England, on the subject of colors in insects, the object of the paper being to introduce a series of illustrations of recent work upon the uses of colors to insects in the struggle for existence.

April 5, 1894.—A paper on the structure of the ovipositor in the Hymenoptera, by Mr. Marlatt, was read by the Corresponding Secretary. Mr. Heidemann exhibited specimens of a number of rare and interesting Hemiptera. Mr. Schwarz offered for publication a description of the Scolytid infesting pine cones. He also gave short notes on the distribution and probable origin of Fuller's Rose Beetle (*Aramigus fulleri*), on the larval habits of the Dermestid (*Cryptorhopalum triste*), and on certain abnormal growths found on the bark of the Paper Mulberry, caused by the Scolytid borer (*Phlœotribus frontalis*). These remarks were accompanied by the exhibition of specimens. Mr. Schwarz showed specimens of small insects mounted on cardboard triangles in such a manner as to leave the sternum free for examination and study. He also exhibited specimens of a Staphylinid (*Oxyporus 5-punctatus*), and called attention to the remarkable secondary sexual characters present in the male.

May 3, 1894.—Rev. P. Jerome Smith and Mr. David M. Little were elected corresponding members. Prof. Riley presented some notes on Margarodes or Ground

Pearls, and exhibited necklaces made of the shells of these insects. Mr. Hubbard also made some remarks on this subject. Mr. Hopkins read a paper entitled "Notes on the Habits of certain Mycetophilids," with descriptions of *Epidapus scabies* n. sp., one of several Dipterous insects, the larvæ of which are directly or indirectly the cause of the so-called potato scab. Prof. Riley exhibited a series of West Indian Termites, comprising *Eutermes morio* and *E. rippertii.* Mr. Benton exhibited nests and living specimens of a bee of the genus Melipona.

June 7, 1894.—President Ashmead congratulated the society upon the attainment of its one hundredth meeting and upon its prosperous career and prospects. The Recording Secretary read a review of the work of the society during the past ten years. Mr. Pergande presented additional observations upon the habits of *Ammophila gryphus* for publication. Mr. Benton read a paper entitled "Observations on the Mating of Queens of *Apis mellifica*," recording two instances of the queen mating the second time. Mr. Chittenden presented for publication some biological notes on certain Coleoptera. Mr. Schwarz read a paper on the composition and extent of the Coleopterous fauna of Alaska. He also read some notes on the West Indian Sugarcane Borer (*Xyleborus perforans*), and showed the difficulty of determining whether this insect really occurs in the United States. Mr. Heidemann exhibited certain rare Pentatomids, and Prof. Riley announced the rearing of perfect females of Margarodes. He showed that Margarodes and Porphyrophora are synonymous.

L. O. HOWARD,
Recording Secretary.

ERRATA.

Page 41, under note "Army Worm in New Mexico," for "*Lecanium*" read *Leucania*.

Page 51, line 3, "*Ichnaspis piliformis*" read *Ischnaspis filiformis;* line 12, for "Terminalis" read Terminalia.

Page 55, fourth line from bottom, for "*Euplectus*" read *Euplectrus*.

Page 74, about middle of third paragraph, for "Deidrocephala" read Diedrocephala.

Page 120, line 6, *delete* "London purple and."

Page 154, tenth line of second paragraph, for "congenor" read congener.

Page 155, under legend of Fig. 5, for "lava" read larva.

Page 185, third line from bottom of third paragraph, for "agriculturist" read apiculturist.

Page 186, line 6, for "reach" read reached.

Page 189, second line of second paragraph, for "*Chœtocnema*" read *Chætocnema*.

Page 193, third line of fourth paragraph, for "*birittata*" read *birittatus;* fourth line of fourth paragraph, for "unusally" read unusually.

Page 197, last line, for "*boisduvallii*" read *boisduvalii*.

Page 208, third line from bottom of first note, for "*Aspidiotus*" (repeated) read *Diaspis*.

Pape 210, third line of second note, for "raspberry" read gooseberry.

Page 216, eleventh line from bottom, for "ommitted" read omitted.

Page 273, about middle of second paragraph, for "*Præpodes*" read *Prepodes*.

Page 278, lines 1 and 2, for "Lownes's" read Lowne's.

Page 280, fourth line of second note, for "Hagan" read Hagen.

Page 282, third line from bottom, for "Diaprinne" read Diapriinæ.

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ABBREVIATIONS USED: Art., article; descr., description; m. or men., mention; n. g. or gen. nov., new genus; n. sp., new species; ref., reference; rem., remarks; rept., report; rev., review; sp., species.
Notices of agricultural experiment station publications are entered under "Experiment Stations."

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